

# THE PHILIPPINE JOURNAL OF SCIENCE

VOL. 25

AUGUST, 1924

No. 2

## BIRDS OF ILOCOS NORTE PROVINCE, LUZON

By RICHARD C. McGREGOR

*Ornithologist, Bureau of Science, Manila*

Birds were collected by myself and assistants at Bangui, Ilocos Norte Province, Luzon, from October 26 to November 24, 1923; at Piddig, from November 25 to December 6; and at Solsona, from December 7 to December 20.

By means of these collections the known habitat of *Gerygone simplex* and of *Oriolus albiloris* is extended to the north coast of Luzon, *Hyloterpe albiventris* is found to be the common species of its genus in the lowlands of the Ilocos provinces, and *Pericrocotus cinereus*, *Calliope calliope*, *Acrocephalus orientalis*, *Horornis canturiens*, *Horornis minutus*, *Anthus cervinus*, *Emberiza sulphurata*, and *Sturnia philippensis* are established as more or less common winter visitants to the area under consideration.

Luzon, north of San Fernando, La Union Province, differs conspicuously from its central and southern parts in having few coastal indentations large enough to serve as harbors for ocean-going vessels. The coastal plain is comparatively narrow in Ilocos Sur and is pinched out in northern Ilocos Norte by the rocky headland of Cape Bojeador. In central Ilocos Norte the plain extends for many kilometers from the coast to the range of mountains on the eastern provincial boundary.

In the widest part of the plain Laoag River is the main stream of an extensive drainage system. The irrigation systems are extensive and long established. From Laoag good roads extend

to Bangui, Vintar, Piddig, Dingras, Bana, and Solsona. There are substantial bridges over the smaller streams, and the larger rivers are crossed on rafts. The low banks and the extensive beds of gravel suggest the difficulty of building permanent bridges. In many places where bridges have been made at great expense and according to the best engineering practice, some unusual flood has wrecked an approach or undermined one or more of the central piers.

In the northern part of Ilocos Norte Province the area available for rice growing is comparatively limited and is in small areas. The hills and the forests extend nearly to the sea. The climate is different from that of the central part of the province. At Bangui the rice was nearly all harvested by the end of November, while at Piddig and Solsona very little rice had been cut, up to the middle of December.

Bangui is at the end of the automobile road and seemed to offer a good base for the study of migration. It was mainly to pick up, if possible, the line of migration of land or water birds that this place was visited.

In the following enumeration the asterisk is used to indicate species of which specimens were collected. Species not so marked were identified by me in the field with reasonable certainty.

#### BIRDS OBSERVED IN ILOCOS NORTE PROVINCE

##### *Gallus gallus* (Linnæus).

A jungle fowl was seen near the road, many kilometers west of Bangui.

##### *Osmotreron axillaris* (Bonaparte).\*

Several specimens of the Philippine green pigeon were collected at Bangui and at Piddig.

##### *Osmotreron vernans* (Linnæus).\*

The pink-necked green pigeon was found at Bangui and at Solsona, but was less abundant than the Philippine green pigeon.

##### *Phapitreron leucotis* (Temminck).\*

The northern white-eared pigeon was collected at Bangui and at Piddig, but was not abundant.

##### *Macropygia tenuirostris* Bonaparte.\*

The slender-billed cuckoo dove was noted at Bangui, and two female specimens were collected at Solsona.

**Streptopelia dussumieri** (Temminck).\*

Dussumier's turtle dove was fairly abundant in the three localities visited. Two birds of the year, collected at Solsona on December 9 and 18, respectively, resemble the adult in the color of the upper parts, but the collar is not well marked. The rusty wood brown on the lower throat, breast, and sides is mixed with the light grayish vinaceous of the adult plumage.

**Enopelia humilis** (Temminck).\*

The red turtle dove was abundant in the three localities visited. Two young females from Solsona, December 17 and 19, respectively, resemble the adult female, except that the black collar is barely indicated on the sides of the neck. The wing feathers present characteristic signs of immaturity, for the primaries and their coverts are tipped with rusty brown, whereas the secondaries and their coverts and some of the scapulars are tipped with light buff or white.

A nest of this species, containing two fresh eggs, was found at Piddig on December 3. It was situated about 6 meters from the ground in a *duhat* tree, *Eugenia cumini* (Linnæus) Druce. The eggs measure, in millimeters, 25.4 by 19.4 and 26.7 by 19.4, respectively. Another egg was found in the oviduct of a female that was collected on December 14. This egg measures 24.5 by 19.6.

**Geopelia striata** (Linnæus).\*

The barred ground dove was the most abundant dove in the three localities visited. At Solsona, on December 19, two large young birds were found in a nest. The nest is a very slight structure of small plant stems and roots. It measures about 10 centimeters in diameter and was situated about 1 meter from the ground in a brush fence. The young birds are about 13 centimeters in total length. The plumage suggests that of the adult, but the colors of the upper parts are reversed, the ground color being dark brown and the narrow bars on the tips of the feathers being avellaneous to wood brown and fawn color. The chin and upper throat are unfeathered; the breast is pale buff, barred with black; and the abdomen and sides are very pale buff.

**Chalcophaps indica** (Linnæus).\*

Specimens of the Indian bronze-winged dove were collected in the three localities visited. In a female from Solsona the largest feather of the right alula is pure white.

*Tachybaptus philippensis* (Bonnaterre).

A few Philippine grebes were seen near Bangui.

*Pluvialis fulvus* (Gmelin).\*

Two specimens of the golden plover in winter plumage were collected at Solsona, December 18 and 19, respectively.

*Charadrius dubius* Scopoli.\*

The little ringed plover was seen along various streams, and one specimen was collected at Bangui.

*Charadrius alexandrinus* Linnaeus.\*

The Kentish plover was fairly abundant on the seabeach at Bangui, where three specimens were collected late in October.

*Actitis hypoleucus* (Linnaeus).\*

Specimens of the common sandpiper were collected at Bangui, and this species was noted at Piddig. No other sandpiper was seen.

*Gallinago stenura* (Bonaparte).\*

A male of the pintail snipe from Solsona, December 13, is the only representative of the genus seen during this trip.

*Rostratula capensis* (Linnaeus).\*

A male of the painted snipe was collected at Piddig on December 4.

*Egretta garzetta* (Linnaeus).\*

A few little white egrets were seen at Bangui.

*Nycticorax nycticorax* (Linnaeus).\*

An immature specimen of the common night heron was collected at Bangui.

*Marila fuligula* (Linnaeus).\*

Ducks were reported to be abundant in the vicinity of Bangui, but the only ones seen by us were a male and a female of the tufted duck which we purchased from a local hunter on November 20.

*Cerchneis tinnunculus* (Linnaeus).\*

A female hawk, that I identify as a young kestrel, was collected at Bangui on November 16. Whitehead's specimen, from

Lepanto, is the only previous record of the kestrel occurring in Luzon. Perhaps some other specific name should be used for Philippine specimens of this genus.

*Bolbopsittacus lunulatus* (Scopoli).\*

The Luzon guaiabero was fairly abundant at Bangui.

*Loriculus philippensis* (P. L. S. Müller).\*

One colasisi was collected at Bangui.

*Aicedo bengalensis* Gmelin.\*

The common small kingfisher was noted at Bangui and at Piddig.

*Halcyon gularis* (Kuhl).\*

The white-throated kingfisher was noted at Bangui and at Piddig.

*Hydrocorax hydrocorax* (Linnæus).

The Luzon calao was fairly abundant near Bangui.

*Penelopides manillæ* (Boddaert).\*

The Luzon tarictic was abundant near Bangui.

*Merops americanus* P. L. S. Müller.\*

Specimens of the chestnut-headed beebird were collected at Bangui and at Solsona.

*Caprimulgus griseatus* Walden.\*

The Philippine nightjar was abundant near each of the towns where collections were made. The birds were found resting on the gravel of dry stream beds and could be collected in broad daylight. They were also seen on the wide sandy seabeach at Bangui.

*Hemiprocne major* (Hartert).\*

Whiskered swifts were collected at Bangui.

*Cacomantis merulinus* (Scopoli).\*

The rufous-bellied cuckoo is represented by specimens from Bangui and from Solsona.

*Centropus viridis* (Scopoli).\*

The red-winged coucal is represented by an immature female from Bangui.

*Xantholæma hæmacephalum* (P. L. S. Müller).\*

The yellow-chinned barbet was fairly abundant near Bangui.

*Yungipicus validirostris* (Blyth).\*

Specimens of the large-billed pygmy woodpecker were collected near Bangui.

*Chrysocolaptes hæmatribon* (Wagler).

No specimen of the golden flicker was collected, but as an individual was watched for several minutes at close range I have no hesitation in adding the name of this species to the Bangui list.

*Lichtensteinipicus funebris* (Valenciennes).\*

A pair of funereal woodpeckers was collected near Bangui.

*Pitta erythrogaster* Temminck.\*

An immature female red-breasted pitta was collected at Bangui.

*Cyornis philippinensis* Sharpe.\*

The Philippine cyornis was found at Bangui.

*Gerygone simplex* Cabanis.\*

Two Philippine gerygones were seen in a small tree several kilometers inland from Burgos, and one of them was killed. This seems to be the most northern record for this erratic species. Another specimen was taken near Piddig.

*Hypothymis occipitalis* (Vigors).\*

This small blue flycatcher occurs in its usual abundance in the vicinity of both Bangui and Piddig.

*Rhipidura cyaniceps* (Cassin).\*

Two specimens of the rufous-bellied fantail were collected at Bangui.

*Rhipidura nigritorquis* Vigors.

The black and white fantail was noted at Piddig.

*Xeocephalus rufus* (Gray).\*

A rufous flycatcher was collected near Solsona.

*Eumyias nigrimentalis* (Grant).\*

Three flycatchers from Solsona appear to be of the same species as numerous skins of *E. nigrimentalis* from the Mountain Province.

*Artamides striatus* (Boddaert).\*

Specimens of the Luzon artamides were collected at Bangui and at Solsona.

*Edolisoma cærulescens* (Blyth).\*

Six specimens of the Luzon cuckoo shrike were collected near Bangui in November.

*Pericrocotus cinereus* Lafresnaye.\*

The ashy minivet was abundant near Bangui late in October and in November. Small flocks were common in trees along roads and in the town.

*Lalage melanoleuca* (Blyth).\*

Two specimens of the black and white lalage were collected at Bangui.

*Lalage niger* (Forster).\*

The pied lalage was fairly abundant at Bangui and at Piddig.

*Iole gularis* (Pucheran).\*

Specimens of the Philippine bulbul were collected at Bangui.

*Pycnonotus goiavier* (Scopoli).

The guava bulbul was noted at Bangui and at Piddig.

*Petrophila manillensis* (J. R. Forster).\*

The eastern rock thrush was abundant in the vicinity of Bangui.

*Calliope calliope* (Pallas).\*

The Siberian rubythroat was abundant at Piddig and at Solsona. It was first noted on December 2. A dozen specimens were collected, more than all the specimens in the Bureau of Science collection.

*Copsychus mindanensis* (Boddaert).\*

The dominico was noted at Bangui and at Piddig.

*Kittacincla luzoniensis* (Kittlitz).\*

The Luzon shama was fairly abundant in the vicinity of Bangui.

*Pratincola caprata* (Linnæus).\*

The pied chat was noted in each of the localities visited.

*Acrocephalus orientalis* (Temminck and Schlegel).\*

The oriental reed warbler is represented by two males, one of them collected at Piddig, December 6; the other, at Solsona, December 15.

*Orthotomus chloronotus* Grant.\*

Specimens of the green-backed tailorbird were collected at Bangui.

*Megalurus palustris* Horsfield.\*

The striated marsh warbler was noted at the three localities visited, and specimens were collected at Piddig and at Solsona.

*Megalurus tweeddalei* McGregor.\*

A specimen of Tweeddale's marsh warbler was collected at Bangui.

*Acanthopneuste borealis* (Blasius).\*

The northern willow warbler was abundant at Bangui, and specimens were collected at Piddig and at Solsona.

*Acanthopneuste xanthodryas* (Swinhoe).\*

Two males of the yellow willow warbler were taken at Bangui, November 11 and 23, respectively.

*Horornis canturiens* (Swinhoe).\*

The Chinese bush warbler was collected at Piddig on November 26 and December 6 and at Solsona on December 8, 9, and 10. All of the five specimens are males.

*Horornis minutus* (Swinhoe).\*

The little bush warbler is represented by three males and four females. The first specimen was collected at Bangui on November 21; the next was collected at Piddig on November 30; four were collected at Piddig on December 6; the last one was taken at Solsona on December 19. This is the first Luzon record for the species.

*Artamus leucorynchus* (Linnaeus).

Swallow shrikes were noted at Bangui and at Piddig.

*Cephalophoneus nasutus* (Scopoli).\*

The large-nosed shrike was noted at Bangui and was fairly abundant in the vicinity of Piddig.

*Otomela lucionensis* (Linnæus).\*

The gray-headed shrike was noted at Bangui and at Piddig.

*Hyloterpe albiventris* Grant.\*

Thickheads were fairly abundant at Piddig and at Solsona; less so at Bangui. Comparison of a dozen specimens from these localities with typical *H. albiventris* from Irisan and Pauai, Mountain Province, shows no differences that may not well be due to difference in season. The Ilocos specimens (November and December) are in fresh plumage, and the Mountain Province birds (April and May) are somewhat worn.

*Pardaliparus elegans* (Lesson).\*

The elegant titmouse was seen at Bangui only, where a pair of adults and an immature bird were taken in November.

*Rhabdornis mystacalis* (Temminck).\*

Five specimens of the Philippine creeper were collected at Bangui.

*Zosterops aureiloris* Grant.\*

Silvereyes were collected in the three localities visited; probably they are *Z. aureiloris*, but I am not certain what that species is.

*Dicæum papuense* (Gmelin).\*

Four specimens of the Philippine flowerpecker were collected at Bangui.

*Dicæum pygmæum* (Kittlitz).\*

Specimens of the pygmy flowerpecker were collected at Bangui and at Solsona.

*Prionochilus inexpectatus* Hartert.\*

A female flowerpecker from Solsona, December 8, belongs to this species.

*Piprisoma æruginosum* (Bourns and Worcester).\*

Four specimens of the rusty flowerpecker were collected at Solsona. Sharpe transferred this species to *Acmonorhynchus* Oates, which was based on a Ceylonese species. I doubt that the two are congeneric.

*Leptocoma henkei* (Meyer).\*

Henke's sunbird was fairly abundant at Bangui and at Piddig.

*Cyrtostomus jugularis* (Linnæus).\*

A male of the yellow-breasted sunbird was collected at Solsona, and two specimens were collected at Piddig.

*Anthreptes griseigularis* Tweeddale.\*

A male and two females of the gray-throated sunbird were collected at Piddig.

*Motacilla melanope* Pallas.\*

A specimen of the gray wagtail was collected at Bangui on October 28, and others were seen near Piddig and near Solsona.

*Budytès leucostriatus* Homeyer.\*

A male of the Siberian yellow wagtail was collected at Bangui on November 16.

*Anthus rufulus* Vieillot.\*

The Indian pipit was noted at each of the localities visited, and two specimens were collected at Solsona.

*Anthus gustavi* Swinhoe.\*

Two specimens of the Petchora pipit were collected at Bangui; others were seen in the same locality.

*Anthus cervinus* (Pallas).\*

Two specimens of the red-throated pipit were collected at Bangui on November 17, and one was collected on December 14. In November, 1903, we found this species abundant on Calayan.

*Passer montanus* (Linnæus).

The tree sparrow was noted at Bangui and at Piddig.

*Emberiza sulphurata* Temminck and Schlegel.\*

A male of the Japanese yellow bunting was collected at Bangui on November 15; another male was collected on the 17th. In December, both males and females were abundant at Piddig and at Solsona. Near the latter town buntings were seen every day along roads and in uncultivated fields.

*Padda oryzivora* (Linnæus).\*

A few Java sparrows were seen about the town of Bangui.

*Munia jagori* Martens.

The Philippine weaver was noted at Bangui and at Piddig.

**Munia cabanisi Sharpe.**

This species was noted at Bangui only. On November 15 seven Cabanis's weavers were noted in a field on the heads of rice; on the 19th four birds of this species were seen in a river bed picking up rice.

**Oriolus acrorhynchos Vigors.\***

The Philippine oriole was fairly abundant in the localities visited by us.

**Oriolus albitorques Grant.\***

The white-lored oriole was seen several times in the forest near Bangui; a female was collected on November 7.

**Dicerurus balicassius (Linnæus).\***

The northern drongo was fairly abundant at Bangui.

**Sturnia philippensis (Forster).\***

A female violet-backed starling was collected at Bangui on October 28.

**Sarcops calvus (Linnæus).\***

Coletos were noted at Bangui and at Piddig. A male collected at Bangui on October 30 is nearer to *S. calvus* than to *S. melanotus*.

**Corvus philippinus Bonaparte.**

The Philippine crow was noted in each of the localities visited.



## CHEMOTHERAPEUTIC EXPERIMENTS WITH CHAUL-MOOGRA AND ALLIED PREPARATIONS

### IV. A SURVEY OF CERTAIN ORGANIC COMPOUNDS AS TO THEIR GROWTH-INHIBITING ACTIVITY TOWARD ACID-FAST BACILLI IN VITRO

By OTTO SCHÖBL<sup>1</sup>

*Of the Serum Laboratory, Bureau of Science, Manila*

It was the aim of the following experiments to survey certain organic compounds, belonging to various groups, with regard to their growth-inhibiting activity toward acid-fast bacilli. It is reasonable to expect that certain organic compounds, highly active chemically, such as the aldehydes, nitro, and hydroxy compounds, will be found strongly antiseptic toward the acid-fast bacilli, as they are so toward other bacteria. Nevertheless, in view of the peculiar selective antiseptic activity of the acids from the chaulmoogric series as well as the unique chemical composition of these bacilli it became highly desirable in the course of our investigation to know if and how far the growth-inhibiting activity of organic compounds follows the known rules that govern the interdependency of chemical structure of organic compounds and their physiologic effect.

Furthermore, there were found indications of semiselective inhibitory action of the constituents of certain volatile oils which made the present survey all the more desirable. It is regretted that the collection of available compounds was not more complete. Thanks are due to the members of the division of organic chemistry, Bureau of Science, and of the department of chemistry, University of the Philippines, for supplying the compounds as well as for their coöperation and advice in the preparation of this paper.

The early investigations of Bechhold and Ehrlich<sup>2</sup> revealed the most varied changes in action when the substituents of phenols varied. Unfortunately, as a rule, with the increase of the antiseptic activity of an aromatic compound, its toxicity increases also, but not necessarily in the same proportion. These authors

<sup>1</sup> Member, Philippine Leprosy Research Board.

<sup>2</sup> Zeitschr. für Physiol. Chem. 47 (1906) 173.

investigated phenols and used *Bacillus diphtheriae*, extending their experiments in certain instances to *Bacillus coli*, *B. pyocyanus*, *B. typhosus*, *Streptococcus*, and *Staphylococcus*.

The general rules as to the antiseptic activity of aromatic compounds can be briefly summarized as follows:

1. The introduction of halogen (Cl, Br) into the nucleus of phenols increases the disinfecting activity of the compound in proportion with the number of halogen atoms.

2. The introduction of alkyl groups in the presence of halogen in the molecule increases the antiseptic activity.

3. Combination of two phenols affects the antiseptic activity as follows:

- (a) Direct; increases.
- (b) By  $\text{CH}_2$ ; increases.
- (c) By  $\text{COOH}$ ; increases.
- (d) By  $\text{CHOR}$ ; increases.
- (e) By  $\text{CO}$ ; diminishes.
- (f) By  $\text{SO}_2$ ; diminishes.

The compounds investigated by me are listed in the appended tables and are arranged according to the chemical groups to which they belong; namely, acids, alcohols, aldehydes, hydrocarbons, amino compounds, phenols, ethers, and terpenes.

#### TECHNIC OF EXPERIMENTATION

The same technic of testing was used in these experiments as that described in a previous paper.<sup>3</sup> Liquids were added to the melted agar in 100 per cent concentration. Substances melting at or below 100° C. were also added in that concentration, while kept on the water bath, by means of hot pipettes. Otherwise, the chemicals were used in concentrated solution (100° C.) as a starting solution. Dilutions were made either in water or in olive oil, according to the solubility of the particular compound.

The medicated tubes were planted with a young rapidly growing culture of *Bacillus tuberculosis*, sealed with paraffine and incubated, and readings made two and four weeks after planting. The smallest amount of a particular chemical which, added to the tube, produced inhibition of growth was designated as titer while the figures given in the tables as value give the relative strength, 1 per cent concentration being taken as one unit. It is evident at once that a precise titration of the growth-inhibiting effect of the compounds was not attempted. Dilutions were made at long intervals and, as a result, considerable differences in effect may have remained unnoticed, particularly with compounds that gave

<sup>3</sup> Philip. Journ. Sci. 23 (1923) 583.

values of 20 or more. On account of the procedure used, the figures given as titer represent the amount by volume, not always of the pure compound, but often of the saturated solution at 100° C. of the compound. The factor of solubility was therefore allowed free play. No doubt, such procedure accounts for the differences in our results as compared with those obtained by others—for instance, in the phenol group. The survey includes numerous chemicals belonging to various and sometimes unrelated groups in the system of organic chemistry. The results obtained by this method of experimentation show the relation between the chemical structure of the compounds and their antiseptic effect as modified by their solubility more plainly than do the results obtained by other workers who disregarded the factor of solubility. It will be seen that the rules deduced from my experiments, of the relation between the chemical composition and the antiseptic effect of organic compounds, agree with those of chemical reactivity and physiological effect.

Table 1 gives the results of tests performed with organic acids. They were tested in the form of slightly alkaline soaps. It can be seen from this table that the antiseptic activity of these soaps, starting with that of formic acid, is comparatively high in the case of the first few members of the series; that is, the water-soluble acids. Then it decreases rather rapidly, beginning with valeric, with the increase of the  $\text{CH}_2$  groups, up to stearic acid. Of the dibasic acids none showed noteworthy growth-inhibiting activity as far as tested.

Tests performed with some derivatives of acetic acid are presented in Table 2. Acetic acid was selected for the study of the effect on the growth-inhibiting activity of the introduction of various elements and groups, because it is one of the acids which showed moderately high effect, so that an increase as well as a decrease could be seen. Furthermore, more derivatives of this acid were available than of any other from this series.

Table 2 shows that sodium, copper, and nickel salts of acetic acid are about equally effective, while zinc, strontium, lead, and uranium compounds show no effect. Dichloracetic acid has a value of at least 20; that is, twice the strength of sodium acetate, while trichloracetic was about equal to sodium copper or nickel acetate (about 10). Potassium chloracetic acid has about the same value as dichloracetic but acetamid and trichloracetamid are considerably lower (less than 2).

Of the organic derivatives of acetic acid, methyl and benzyl compounds are without much effect; bornyl showed slight effect

(more than 1); but phenyl surpassed all other derivatives tested (about 100).

In the series of aromatic carboxy acids (Table 1), benzoic acid gave a value of less than 1, showing that the carboxyl group attached directly did not release the antiseptic effect inherent in the benzol ring. A hydroxyl group in ortho position to carboxyl on the ring raises the antiseptic effect in salicylic acid somewhat more than it does on the side chain in mandelic acid. It remains insignificant in oxycinnamic (cummaric) acid where the OH group is on the ring and a carboxyl is bound to the ring by a double-bonded group  $\text{CH}=\text{CH}$  on the side chain. On the other hand, in cinnamic acid, where the carboxyl is linked to a phenyl group by a double-bonded group  $\text{CH}=\text{CH}$ , the antiseptic effect rises to 100. Evidently the phenyl group in the latter acid develops its full antiseptic effect, which is not the case with oxycinnamic acid; nor can the phenyl in hydrocinnamic acid act fully, although present, owing to the absence of the double bond.

The esters of organic acids (Table 3) proved to be of low antiseptic value. Such inhibition as was noticed in certain instances was only partial, although to rather high dilution. The experience that esters (of chaulmoogra oil, for instance) give no complete inhibition of growth in low dilutions, but that partial inhibition of growth is noticeable in low and high dilutions can be explained by what can be termed the storage effect of the esters. The growing bacilli split the ester and a small amount of the growth-inhibiting acid is set free. The liberated amount of the acid is not sufficient completely to stop the growth but a lag results in the multiplication of bacilli.

It is evident from Table 4 (alcohols) that the growth-inhibiting activity of the saturated alcohols, from methyl to melissyl, is insignificant (less than 1). Butyl alcohol gave higher value than isobutyl, and primary octyl alcohol likewise showed slightly higher inhibition than the corresponding secondary alcohol.

Phenyl ethyl alcohol, both primary and secondary, gave value 2. The unsaturated allyl alcohol gave value 2, but the phenyl allyl alcohol inhibited growth in as high a dilution as benzyl alcohol (more than 20) which is a value somewhat higher than that of phenol.

As was expected, the growth-inhibiting effect of aldehydes is considerable (Table 5). Compared with the well-known formaldehyde, which found practical application in medicine, the pleasant-smelling and nonirritating benzaldehyde and, particu-

larly, the cinnamyl aldehyde surpass formaldehyde in growth-inhibiting action toward acid-fast bacilli.

It was noticed in the series of alcohols tested that unsaturated alcohols which are good fat solvents had little or no growth-inhibiting effect upon acid-fast bacilli. Strong hypnotics, like some of the members of the series given in Table 6, which are at the same time strong fat solvents, have not such growth-inhibiting effect as one might expect, considering the chemical composition of acid-fast bacilli.

The results of tests performed with certain nitro compounds are given in Table 7. The most striking finding is the great difference between the effect of aniline and benzylamine. The behavior of the amino group is apparently quite the reverse of that of the alkyl group with regard to the influence it has on the antiseptic effect of the benzol ring. While the alkyl increases the antiseptic effect of phenol when located on the ring, it has quite the reverse effect when on the side chain; but the differences are far greater in case of the amino group and the effect is reversed. Aniline showed hardly any effect at all (less than 1) while benzylamine tested more than a hundred times stronger. The aniline being without effect (less than 1) the alkylation of the amino group does not affect its antiseptic activity. Further introduction into aniline of an amino group raises its activity somewhat even in para position, as in paraphenylenediamine (more than 2). The NH<sub>2</sub> group linked to a phenyl by CH<sub>2</sub> in benzylamine gave a value of more than 100, while the strongly mitigating effect of carbonyl is evident in benzamide (about 1). The NH<sub>2</sub> group in benzylamine acts evidently as a hapto-phore group, bringing out the strongly toxic effect of the phenyl group.

Table 8 (on phenols) gives the results of tests with certain organic hydroxy compounds. The monohydroxy phenol gave a value of 20; both meta and para dihydroxyphenol inhibited to about the same degree, slightly below the value of phenol; but the orthodihydroxyphenol gave a higher value than mono phenol or meta or para dihydroxyphenol. The 1, 2, 3 trihydroxyphenol gave a value of more than 100. On the other hand, phloroglucinol which is 1, 3, 5 trihydroxyphenol was found practically inactive. The alkylation on the ring in phenol increased the antiseptic effect, particularly in orthocresol. Double alkylation of phenol on the ring with methyl and isopropyl increased the antiseptic value, as shown by the results for carvacrol.

Anisol (Table 8, on ethers), which has a methyl and phenyl group linked by O, gave value 2, showing that methylation of

the hydroxy group in phenol decreases the effect, whereas alkylation on the ring in cresols increases it. In dihydroxyphenols the alkylation, of one OH only, has apparently little effect on the growth-inhibiting action as shown by the guajacol value (more than 100). Complete methylation of hydroxyls decreases the growth-inhibiting activity in dihydroxyphenol (veratrol). The introduction into the mono methyl ether of the  $\text{CH}_2\text{CH}=\text{CH}_2$  group (vanilin) evidently decreases its effect.

Table 9 (terpenes) shows the open-chain compounds citral, citronellal, and linalool to be equally effective and about ten times more effective than their cyclic isomers. Compare citral (20) with pulegone (more than 2); linalool and citronellal (20) with terpineol (less than 1).

Among the cyclic compounds carvone tested somewhat stronger than phenol. Carvene showed only slight inhibitory effect, whereas pulegone and menthol gave a value of more than 2. Terpineol proved to be practically ineffective.

#### SUMMARY

1. Water-soluble compounds showed an antiseptic effect, whereas the fat solvents such as benzol, toluol, xylol, carbon trichloride, and carbon tetrachloride which have a strong hypnotic effect were found to be only slightly antiseptic or not at all.

2. Sodium, copper, and nickel salts of fatty acids were found about equally effective whereas zinc, strontium, lead, and uranium salts showed no effect.

3. The double-bond-containing compounds all showed antiseptic effect, the double bond being more effective on the side chain than on the ring in aromatic compounds.

4. Unsaturated alcohols showed an antiseptic effect, particularly when containing the phenyl group which proved to be the most powerful toxic group.

5. High alcohols approaching waxes showed no effect. Secondary alcohols were equally or less effective than primary alcohols.

6. Hydroxy compounds are highly antiseptic toward acid-fast organisms, as they are toward other bacteria.

7. The antiseptic effect of phenols increases with the number of hydroxyl groups, the position of these groups being of importance, as the ortho compounds are more antiseptic than the para or meta compounds.

8. Alkylation on the ring increases the antiseptic effect of phenols, whereas alkylation on the OH group of polyhydroxy-

phenols has no noteworthy effect, provided at least one hydroxyl is preserved free.

9. The amino group ( $\text{NH}_2$ ) has a reverse effect on the anti-septic power of the aromatic compounds, in as much as it has no effect when located on the ring but is strongly antiseptic when linked to the ring directly on the side chain. It acts as a haptophore group and the strong effect of benzylamine is no doubt due to the function of the phenyl group.

10. Open-chain terpenes are more effective than their cyclic isomers.

11. In the cyclic hydrocarbons the double bond in the ring seems to be of importance in the presence of other groups on the ring, but not in itself.

TABLE 1.—*Results of growth-inhibiting tests with organic acids.*

Name of acid.	Chemical formula.	Growth-inhibiting value.
Formic.....	H COOH.....	> 10
Acetic.....	CH <sub>3</sub> COOH.....	10
Propionic.....	CH <sub>2</sub> (CH <sub>2</sub> ) COOH .....	10
Butyric.....	CH <sub>3</sub> (CH <sub>2</sub> ) <sub>2</sub> COOH.....	10
Valeric.....	CH <sub>3</sub> (CH <sub>2</sub> ) <sub>3</sub> COOH.....	< 1
Caprylic.....	CH <sub>3</sub> (CH <sub>2</sub> ) <sub>6</sub> COOH.....	2
Lauric.....	CH <sub>3</sub> (CH <sub>2</sub> ) <sub>10</sub> COOH.....	> 2
Myristic.....	CH <sub>3</sub> (CH <sub>2</sub> ) <sub>12</sub> COOH.....	> 1
Palmitic.....	CH <sub>3</sub> (CH <sub>2</sub> ) <sub>14</sub> COOH.....	< 1
Stearic.....	CH <sub>3</sub> (CH <sub>2</sub> ) <sub>16</sub> COOH.....	< 1
Crotonic.....	CH <sub>3</sub> CH=CH COOH.....	< 2
Oleic.....	CH <sub>3</sub> (CH <sub>2</sub> ) <sub>7</sub> CH=CH(CH <sub>2</sub> ) <sub>7</sub> COOH.....	> 2
Oxalic.....	COOH..... COOH.....	< 1
Succinic.....	CH <sub>2</sub> COOH..... CH <sub>2</sub> COOH.....	< 1
Citric.....	CH <sub>2</sub> COOH..... C(OH) COOH..... CH <sub>2</sub> COOH.....	< 1
Malic.....	CH <sub>3</sub> COOH..... (CH(OH) COOH.....	< 1
Tartaric.....	(CH(OH) COOH..... (CH(OH) COOH.....	< 1
Benzoic.....	C <sub>6</sub> H <sub>5</sub> COOH.....	< 1
Hydrocinnamic.....	C <sub>6</sub> H <sub>5</sub> CH <sub>2</sub> CH <sub>2</sub> COOH.....	< 1
Cinnamic.....	C <sub>6</sub> H <sub>5</sub> CH=CH COOH.....	> 100
Oxycinnamic.....	C <sub>6</sub> H <sub>4</sub> (OH) CH=CH COOH.....	< 1
Mandelic.....	C <sub>6</sub> H <sub>5</sub> CH(OH) COOH.....	> 1
Salicylic.....	(O) C <sub>6</sub> H <sub>4</sub> (OH) COOH.....	> 2
Gallic.....	C <sub>6</sub> H <sub>2</sub> (OH) <sub>3</sub> COOH .....	2
Tannic.....	C <sub>14</sub> H <sub>10</sub> O <sub>9</sub> .....	< 10
Phthalic.....	(O) C <sub>6</sub> H <sub>4</sub> (COOH) <sub>2</sub> .....	> 1
Terephthalic.....	(P) C <sub>6</sub> H <sub>4</sub> (COOH) <sub>2</sub> .....	< 1

TABLE 2.—*Results of growth-inhibiting experiments with certain derivatives of acetic acid.*

Name of compound.	Growth-inhibiting value.
Sodium acetate.....	< 10
Copper acetate.....	< 10
Nickel acetate.....	< 10
Zinc acetate.....	< 1
Strontium acetate.....	< 1
Lead acetate.....	< 1
Basic lead acetate.....	< 1
Uranyl acetate.....	< 1
Potassium chloracetic acid.....	< 100
Dichloracetic acid.....	< 100
Trichloracetic acid.....	< 10
Acetamid.....	< 2
Trichloracetamid.....	< 2
Methyl acetate.....	< 1
Benzyl acetate.....	< 1
Phenyl acetate.....	100
Bornyl acetate.....	< 2

TABLE 3.—*Results of growth-inhibiting tests with esters of organic acids.*

Name of compound.	Chemical formula.	Growth-inhibiting value.
Methyl valeate.....	$\text{CH}_3(\text{CH}_2)_3\text{COOCH}_3$ .....	< 1
Ethyl lactate.....	$\text{CH}_3\text{CH}(\text{CH})\text{COOC}_2\text{H}_5$ .....	< 1
Methylbenzoate.....	$\text{C}_6\text{H}_5\text{COOCH}_3$ .....	
Ethylanisate.....	$\begin{array}{c} \text{OCH}_3 \\   \\ \text{C}_6\text{H}_4 \\   \\ \text{COOC}_2\text{H}_5 \end{array}$	< 1
Ethyl glycolate.....	$\begin{array}{c} \text{OH} \\   \\ \text{CH}_2 \\   \\ \text{COOC}_2\text{H}_5 \end{array}$	< 2
Ethyl ester, cod-liver oil.....	.....	< 1
Ethyl ester, chaulmoogra oil.....	.....	> 1
Ethyl ester, chaulmoogric acid.....	.....	1
Allyl ester, chaulmoogric acid.....	.....	> 1
Capryl ester, chaulmoogric acid.....	.....	< 1

TABLE 4.—Results of growth-inhibiting experiments with alcohols.

Name of alcohol.	Chemical formula.	Growth-inhibiting value.
Methyl.....	CH <sub>3</sub> OH.....	< 1
Ethyl.....	C <sub>2</sub> H <sub>5</sub> OH.....	< 1
Propyl.....	C <sub>3</sub> H <sub>7</sub> OH.....	< 1
	CH <sub>3</sub> .....	
Isopropyl.....	CH OH.....	< 1
	CH <sub>3</sub> .....	
Butyl.....	C <sub>4</sub> H <sub>9</sub> OH.....	1
	CH <sub>3</sub> .....	
Isobutyl.....	CH <sub>3</sub> / CH CH <sub>2</sub> OH.....	< 1
	CH <sub>3</sub> /	
Heptyl.....	CH <sub>3</sub> (CH <sub>2</sub> ) <sub>5</sub> CH <sub>2</sub> OH.....	< 1
Octyl, normal.....	CH <sub>3</sub> (CH <sub>2</sub> ) <sub>6</sub> CH <sub>2</sub> OH.....	1
Octyl, secondary.....	CH <sub>3</sub> (CH <sub>2</sub> ) <sub>5</sub> CH <sub>2</sub> OH.....	< 1
Cetyl.....	CH <sub>3</sub> (CH <sub>2</sub> ) <sub>14</sub> CH <sub>2</sub> OH.....	< 1
Melisyl.....	C <sub>10</sub> H <sub>21</sub> OH.....	< 1
Piperonyl.....	CH <sub>3</sub> < O > C <sub>6</sub> H <sub>5</sub> CH <sub>2</sub> OH.....	1
Phenyl ethyl, primary.....	C <sub>6</sub> H <sub>5</sub> CH <sub>2</sub> CH <sub>2</sub> OH.....	2
Phenyl ethyl, secondary.....	C <sub>6</sub> H <sub>5</sub> CH OH CH <sub>2</sub> .....	2
Allyl.....	CH <sub>2</sub> =CH CH <sub>2</sub> OH.....	2
Phenyl allyl.....	C <sub>6</sub> H <sub>5</sub> CH=CH CH <sub>2</sub> OH.....	> 20
Benzyl.....	C <sub>6</sub> H <sub>5</sub> CH <sub>2</sub> OH.....	> 20

TABLE 5.—Results of growth-inhibiting tests with aldehydes.

Name of compound.	Chemical formula.	Growth-inhibiting value.
Formaldehyde.....	O H—C—H.....	> 10
Cinnamyl aldehyde.....	C <sub>6</sub> H <sub>5</sub> —CH=CH CHO.....	< 500
Benzaldehyde.....	C <sub>6</sub> H <sub>5</sub> CHO.....	20
Isopropylbenzaldehyde.....	(CH <sub>3</sub> ) <sub>2</sub> CH C <sub>6</sub> H <sub>4</sub> CHO. (I).....	< 10

TABLE 6.—*Results of growth-inhibiting experiments with hydrocarbons, their halogen and other derivatives.*

Name of compound.	Chemical formula.	Growth-inhibiting value.
Benzol.....	C <sub>6</sub> H <sub>6</sub> .....	< 1
Toluol.....	C <sub>6</sub> H <sub>5</sub> CH <sub>3</sub> .....	< 1
Xylool.....	C <sub>6</sub> H <sub>5</sub> (CH <sub>3</sub> ) <sub>2</sub> .....	1
Carbon trichloride.....	CH Cl <sub>3</sub> .....	< 1
Carbon tetrachloride.....	C Cl <sub>4</sub> .....	10
Ethylene bromide.....	[CH <sub>2</sub> Br.....	2
	[CH <sub>2</sub> Br.....	
Brombenzol.....	C <sub>6</sub> H <sub>5</sub> Br.....	2
Ethylbenzol.....	C <sub>6</sub> H <sub>5</sub> CH <sub>2</sub> CH <sub>3</sub> .....	1
Benzylbromide.....	C <sub>6</sub> H <sub>5</sub> CH <sub>2</sub> Br.....	
Naphthaline.....	C <sub>10</sub> H <sub>8</sub> .....	
A-Naphthol.....	C <sub>10</sub> H <sub>7</sub> OH.....	1
B-Naphthol.....	C <sub>10</sub> H <sub>7</sub> OH.....	> 1

TABLE 7.—*Results of growth-inhibiting tests with nitro compounds.*

Name of compound.	Chemical formula.	Growth-inhibiting value.
Urea.....	NH <sub>2</sub> CO NH <sub>3</sub> .....	< 1
Ethylamine.....	C <sub>2</sub> H <sub>5</sub> NH <sub>2</sub> .....	> 10
Diethylamine.....	(C <sub>2</sub> H <sub>5</sub> ) <sub>2</sub> NH.....	> 10
Diphenylamine.....	(C <sub>6</sub> H <sub>5</sub> ) <sub>2</sub> NH.....	> 10
Paraphenylenediamine.....	C <sub>6</sub> H <sub>4</sub> NH <sub>2</sub> (1)..... C <sub>6</sub> H <sub>4</sub> NH <sub>2</sub> (4).....	> 2
Benzylamine.....	C <sub>6</sub> H <sub>5</sub> CH <sub>2</sub> NH <sub>2</sub> .....	> 100
B-Naphthylamine.....	C <sub>10</sub> H <sub>7</sub> NH <sub>2</sub> .....	> 10
Benzamide.....	C <sub>6</sub> H <sub>5</sub> CO NH <sub>2</sub> .....	1
Aniline.....	C <sub>6</sub> H <sub>5</sub> NH <sub>2</sub> .....	< 1
Dimethylaniline.....	C <sub>6</sub> H <sub>5</sub> N(CH <sub>3</sub> ) <sub>2</sub> .....	< 1
Picric acid.....	C <sub>6</sub> H <sub>2</sub> OH (NO <sub>2</sub> ) <sub>3</sub> (1, 2, 4, 6.).....	< 1
(O) Amidobenzoicacid.....	C <sub>6</sub> H <sub>4</sub> NH <sub>2</sub> ..... C <sub>6</sub> H <sub>4</sub> COOH.....	1
(P) Amidobenzoicacid.....	C <sub>6</sub> H <sub>4</sub> NH <sub>2</sub> ..... C <sub>6</sub> H <sub>4</sub> COOH.....	< 1
(M) Amidobenzoicacid.....	C <sub>6</sub> H <sub>4</sub> NH <sub>2</sub> ..... C <sub>6</sub> H <sub>4</sub> COOH.....	< 1
Pyridine.....	C <sub>6</sub> H <sub>5</sub> N.....	< 10

TABLE 8.—Results of growth-inhibiting experiments with phenols and ethers.

Name of compound.	Chemical formula.	Growth-inhibiting value.
Phenol	C <sub>6</sub> H <sub>5</sub> OH	20
Cresol, ortho	(o) C <sub>6</sub> H <sub>4</sub> CH <sub>3</sub> (1) OH (2)	100
Cresol, meta	(m) C <sub>6</sub> H <sub>4</sub> CH <sub>3</sub> (1) OH (3)	20
Cresol, para	(p) C <sub>6</sub> H <sub>4</sub> CH <sub>3</sub> (1) OH (4)	20
Carvacrol	C <sub>6</sub> H <sub>5</sub> —CH <sub>3</sub> (1) C <sub>6</sub> H <sub>3</sub> —OH (3) CH (CH <sub>3</sub> ) <sub>2</sub> (4)	> 20
Catechol	(O) C <sub>6</sub> H <sub>4</sub> OH (1) OH (2)	< 200
Resorcinol	C <sub>6</sub> H <sub>4</sub> OH (1) OH (3)	> 10
Hydrochinon	C <sub>6</sub> H <sub>4</sub> OH (1) OH (4)	> 10
Pyrogallol	C <sub>6</sub> H <sub>3</sub> OH (2) OH (3) OH (1)	< 200
Phloroglucinol	C <sub>6</sub> H <sub>3</sub> OH (3) OH (5)	< 1
Anisol	C <sub>6</sub> H <sub>5</sub> —O CH <sub>3</sub> OH (1)	2
Guajacol	(O) C <sub>6</sub> H <sub>4</sub> OCH <sub>3</sub> (2)	> 100
Veratrol	(o) C <sub>6</sub> H <sub>4</sub> OCH <sub>3</sub> (1) OCH <sub>3</sub> (2)	< 20
Eugenol	C <sub>6</sub> H <sub>3</sub> OCH <sub>3</sub> (2) CH <sub>2</sub> CH=CH <sub>2</sub> (4)	> 20
Vanilin	C <sub>6</sub> H <sub>3</sub> OCH <sub>2</sub> (3) CHO (1) CH <sub>2</sub> CH=CH <sub>2</sub> (1)	> 10
Safrol	C <sub>6</sub> H <sub>3</sub> OCH <sub>2</sub> (3) O (4)	10
Anethol	(P) C <sub>6</sub> H <sub>4</sub> O CH <sub>3</sub> CH=CH CH <sub>3</sub>	< 1

TABLE 9.—*Results of growth-inhibiting tests with terpenes.*

## TERPENES

Name of compound.	Chemical formula.	Growth-inhibiting value.
Citral	$(\text{CH}_3)_2\text{C}=\text{CH}(\text{CH}_2)_3\text{C}(\text{CH}_3)=\text{CHCHO}$	20
Citronellal	$\text{CH}_2=\text{C}(\text{CH}_3)(\text{CH}_2)_3\text{CH}(\text{CH}_3)\text{CH}_2\text{CHO}$	20
Linalool	$(\text{CH}_3)_2\text{C}=\text{CH}(\text{CH}_2)_2\text{C}(\text{CH}_3)(\text{OH})\text{CH}=\text{CH}_2$	20
CYCLIC TERPENES		
Carvene		1
Carvone		>20
Pulegone		> 2
Menthol		> 2
Terpineol		< 1
Camphene		< 1
Camphor		> 2
Camphoric acid		< 1

## CHEMOTHERAPEUTIC EXPERIMENTS WITH CHAULMOOGRA AND ALLIED PREPARATIONS

### V. AN INQUIRY INTO THE MECHANISM AND NATURE OF THE GROWTH-INHIBITING EFFECT OF CHAULMOOGRA AND OTHER VEGETABLE OILS

By OTTO SCHÖBL<sup>1</sup>

*Of the Serum Laboratory, Bureau of Science, Manila*

From the many problems which undoubtedly are involved in chaulmoogra therapy I have selected and isolated from the others one which, being fundamental in chemotherapeutics, is at the same time accessible to solution by laboratory experimentation; that is, the direct action of the oil or its constituents upon acid-fast bacteria.

The pioneer work of Walker and Sweeney<sup>2</sup> brought about a better understanding of the working of this useful drug in that these authors pointed out particularly the specificity of chaulmoogra toward acid-fast bacteria, an activity of the acids from the chaulmoogric series which is lacking in other oils. Therefore, it is reasonable to conclude that any therapeutic result, achieved by the use of oils and fats other than chaulmoogric acid, must be interpreted as having been accomplished by means of some of the other factors than the direct selective antiseptic action upon the acid-fast bacteria and need not necessarily be underestimated.

It was the object of the previous and the present investigations to enlarge, if possible, on the information already furnished by the work of Walker and Sweeney, further to probe the feasibility of Walker's explanation of the direct action of chaulmoogric acids upon the acid-fast bacteria and, if this theory should be found supported by experimental evidence, to search for the particular "group or arrangement of atoms which is toxic for the bacterial cell" (Walker).<sup>2</sup>

<sup>1</sup> Member, Philippine Leprosy Research Board.

<sup>2</sup> The chemotherapeutics of the chaulmoogric acid series and other fatty acids in leprosy and tuberculosis, Journ. Inf. Dis. 1 (1920) 1.

This problem was approached by a study of the growth-inhibiting activity of chaulmoogric acids in which the arrangement of atoms has been changed or new elements or groups introduced and, furthermore, by a similar study of chemicals from the hydroaromatic group having various arrangements of the hydrocarbon ring to a certain extent similar to the structure of the ring in the formula of chaulmoogric acids as suggested by Barrowcliff and Powers.<sup>3</sup>

In judging the growth-inhibiting effect of oils and like substances *in vitro* one must consider factors which might be responsible for the nondevelopment or the scanty growth on a culture medium to which the substances have been added.

First is the mechanical factor. In using solid media and a large amount of oily substance the minute droplets may come so close together that they displace the culture medium proper, and for that and concomitant reasons the conditions become unfavorable for the growth of the particular bacterium. It is therefore advisable not to use too high a concentration of the oil in making tests.

Another factor is the possible high degree of acidity of the particular oil which may bring the reaction of the culture medium beyond the maximum acidity limit of growth. The possible errors due to this factor can be eliminated if one controls the results obtained in the oils by tests with corresponding alkaline soaps.

In the case of a drying oil, particularly, the fact must be considered that, during the process of drying, the oil may use up a considerable amount of oxygen and thus render the atmosphere in a closed tube anærobic. Furthermore, secondary volatile products are given off during the process of drying which in themselves may be or are known to be antiseptic.

For instance, according to Friend,<sup>4</sup> the bulk of the vapors evolved during the drying of linseed oil is water; but carbon dioxide, carbon monoxide, formic, butyric, acetic, and acrylic acids have also been detected. Furthermore, the factor of solubility of the active principle enters, as do also the chemical changes which the active principle undergoes on standing and during the performance of the test itself.

<sup>3</sup>Journ. Chem. Soc. 87 (1905) 884.

<sup>4</sup>The Chemistry of Linseed Oil. London, Gurney and Jackson (1917) 50.

An illustration of the interference of the factor of solubility with the results of inhibition tests is found in the experiments reported in an earlier paper.<sup>5</sup>

Chaulmoogra oil showed an inhibitory titer of 0.05; that is to say, 0.05 cubic centimenter of the oil added to 10 cubic centimeters of agar inhibited completely the growth of *Bacillus tuberculosis*. The easily soluble sodium salt of the total fatty acids of the same oil, in a 3 per cent solution, gave a titer of 0.01. Recalculated, it brings the titer of total fatty acids in the form of soluble soap to about 0.0003, which is a much higher inhibitory effect than the calculated titer of the total fatty acids in the form of oil. Naturally, the action of sodium gynocardate as a soap enters also.

On the other hand, the inhibiting effect of sodium chaulmoograte was found to be considerably lower than that of the hydnocarpate. This fact might lead to the erroneous conclusion that chaulmoogric acid is an inferior constituent of the chaulmoogra oil, but such conclusion is contradicted by the finding that *Hydnocarpus alcalæ* oil gives about the same inhibitory value as chaulmoogra, in spite of the fact that it contains largely chaulmoogric acid and very little, if any, hydnocarpic acid, according to investigations of Brill.<sup>6</sup>

In order to ascertain whether the inhibition of growth, as detected in earlier experiments,<sup>7</sup> when certain vegetable oils were brought in direct contact with the freshly inoculated culture, is due to their volatile constituents, to volatile secondary products evolved during drying of the oil, or to the stable constituents of the oil, experiments were arranged to permit study of the growth of acid-fast bacilli in the atmosphere of the vapors given off, without the substance under test coming in direct contact with either the growing culture or the medium on which it was planted.<sup>8</sup>

A comparison of the results of these two parallel tests carried out with the same oils gives an explanation of the nature and mechanism of their inhibition of growth in vitro.

<sup>5</sup> Philip. Journ. Sci. 23 (1923) 533.

<sup>6</sup> A chemical investigation of the seeds of *Pangium edule* and *Hydnocarpus alcalæ*, Philip. Journ. Sci. § A 12 (1917) 37.

<sup>7</sup> Philip. Journ. Sci. 24 (1924) 23.

<sup>8</sup> Philip. Journ. Sci. 23 (1923) 533-542; 24 (1924) 23-27 and 443-445.

It is evident from Table 1 that the nature of the inhibition of growth produced by the essential oils is different from that caused by chaulmoogra oil and hydnocarpus oil, in as much as the essential oils inhibit the growth of acid-fast bacilli by their volatile constituents, which is not the case with chaulmoogra and hydnocarpus oils. Nevertheless, it is interesting to note that the volatile oils do inhibit *Bacillus tuberculosis* and that this inhibition, in some cases at least, shows a strong indication of being selective toward the acid-fast bacilli. Further information as to the activity of the constituents of the essential oils has been obtained by experiments already published.<sup>9</sup> Since cedar oil inhibits the growth of *B. tuberculosis* perceptibly by its volatile constituents, although not completely, there remain out of our collection practically only two oils, besides the chaulmoogra and hydnocarpus, which under the arrangement of tests adopted in this experiment behaved similarly to the oils containing the peculiar acids from the chaulmoogric series.

As these oils, palomaria and cashew, are known not to contain the acids from the chaulmoogra series, we must look to other nonvolatile constituents for explanation. In the case of palomaria, the resin separated from the oil inhibited the growth of *B. tuberculosis* when brought into direct contact with a freshly inoculated culture, and it is most likely responsible for the activity of the crude oil.

The cashew oil obtained from the kernel of the seed is, according to Watt,<sup>10</sup> equal to almond oil in its quality but, according to the same author, a yellowish acrid and highly caustic oil is obtained from the shell of the seed and is said to be useful for preservation of wood, books, etc., against white ants. This substance, cardole, mixed with the cashew oil, very likely is responsible for the inhibition of growth that occurred in our test.

It was quite natural to look to the chemistry of chaulmoogra oil for the explanation of its specific curative value in leprosy and of its selective growth-inhibiting action upon acid-fast bacilli.

Two chemical properties, particularly, of chaulmoogra oil were considered as probably explanatory of its therapeutic

<sup>9</sup> Philip. Journ. Sci. 23 (1923) 533-542; 24 (1924) 23-27 and 443-445.

<sup>10</sup> See West, A. P., and Brown, W. H., Philippine Resins, Gums, Seed Oils, and Essential Oils, P. I. Bureau of Forestry Bull. No. 22, 2 (1921) 146.

effect in the treatment of leprosy; namely, the degree of unsaturation and the chemical structure of the fatty acids, the latter differing radically from the structure of the fatty acids obtained from any other known vegetable oil.

As far as the growth-inhibiting effect of vegetable oils in general is concerned, the degree of unsaturation in itself can be disregarded as the cause of the selective antiseptic action, as will be seen from results of experiments shown in Table 2.

In Table 2 nonvolatile oils are tabulated, as far as they have been tested by us; their degree of unsaturation, as indicated by the iodine number (from Lewkowitsch<sup>11</sup>), is given in one column, and their growth-inhibiting titer and value are given in columns 3 and 4.

In analyzing the results, with the view to detect whether or not there is any relation between the degree of unsaturation and the inhibitive action of the particular oil, one can see that linseed, maize, kapok, cod-liver, shark-liver, and sesame oils show a higher degree of unsaturation (iodine number higher than 104) than chaulmoogra, but their growth-inhibiting value is equal to zero; while chaulmoogra, with a growth-inhibiting value of 20 and more has the iodine number 90.7 to 104. The member of our collection having the highest degree of unsaturation, linseed oil (iodine number 173 to 201), gives a growth-inhibiting value equal to zero, whereas coconut oil, having the lowest iodine number (8 to 10) has a growth-inhibiting value of 1.

The second highest unsaturated oil, bagilumbang (iodine number 158.5 to 166), has a value of 1, while lumbang, with about the same iodine number in 1 per cent concentration, stimulates the growth of *Bacillus tuberculosis* rather than inhibits it.

*Gynocardia odorata* oil, which is obtained from a plant closely related to those that yield chaulmoogra, is biologically inactive in spite of the fact that its degree of unsaturation is higher (iodine number 152.8) than chaulmoogra, which has a very marked growth-inhibiting effect.

The quantitative differences in the degree of unsaturation are rather slight, it is admitted, with those oils that contain the optimally active fatty acids; but, even so, we find that *Hydnocarpus wightiana* oil, which inhibits the growth to the highest dilution

<sup>11</sup> Chemical Technology and Analysis of Oils, Fats, and Waxes, ed. 6 (1921).

used with all the related oils tested, has not the highest iodine number.

There being sufficient experimental evidence to the contrary, the theory which would explain the selective growth-inhibiting effect in vitro with regard to the acid-fast bacilli by the unsaturation of oils alone becomes untenable; there remains the peculiar structure of the acids of the chaulmoogric group as the only explanation, particularly when the possibility has been eliminated that constituents other than the fatty acids are the active principle.

Walker<sup>12</sup> suggested, as an explanation of the chemical process responsible for the antiseptic effect of chaulmoogra oil, Ehrlich's side-chain theory. He says:

Fat elaborating bacilli attempt to utilize the chaulmoogric acids to build up their fatty capsules, and these cyclic fatty acids contain a group or an arrangement of atoms which is toxic for the bacterial cell. In the terminology of Ehrlich's side chain theory, we may express this reaction by saying that chaulmoogric acids possess a haptophore group which becomes attached to the receptor or side chain of the acid fast bacillus, and a toxophore group which, after attachment, exerts a toxic action on the bacillus.

With this hypothesis in mind one is tempted to assume that vegetable oils, so far as their bacteriotoxic action is concerned, have a haptophoric group (which is their condition of unsaturation) and a group of specific inhibition (which is their chemical structure), in other words, their toxophore group; while other oils have their haptophore group (unsaturation) and their nutriphore group or, in the words of Walker, a group or an arrangement of atoms which is stimulating to the growth of the bacterial cell. If this be true, the removal of the haptophore function (that is, the complete saturation by a biologically inert substance) should deprive the oil of its growth-inhibiting or growth-stimulating power, as the case may be, unless these properties of the oil are due to some other substance than the fatty acids present in the particular oil.

Table 3 gives the results of parallel tests of a sample of chaulmoogra oil compared with the same chaulmoogra oil after it has been partially and completely saturated with iodine. The partially saturated chaulmoogra oil was prepared by adding iodine in solution until it retained the dark color, while the completely saturated sample of the oil was prepared by the

<sup>12</sup> Walker, E. L., and Sweeney, M. A., Journ. Inf. Dis. 1 (1920) 1.

Hanus method. The test included a sodium soap of the total fatty acids of chaulmoogra oil partially saturated with iodine and the same soap in its original condition.

The results would indicate that partial saturation with iodine neither decreases nor increases the growth-inhibiting power of chaulmoogra oil, whereas complete saturation deprives the oil of its growth-inhibiting activity. In view of the fact that chaulmoogra saturated with iodine is being used in leprosy therapy, these findings are of interest. From the theoretical standpoint, however, the objection must be raised that, through the saturation of the oil by iodine, a new element has been introduced into the composition of the fatty acids and we are, therefore, dealing with a different chemical compound, so that the conclusions drawn from its biological behavior cannot be applied to the original compound. Furthermore, the completely saturated chaulmoogra oil was a very heavy viscous oil, the even emulsification of which in agar was very difficult and incomplete.

It was necessary, therefore, to arrange experiments with hydrogenized oil; that is, chaulmoogra oil saturated with hydrogen, which is an element already present in the fatty acids of this oil.

Through the courtesy of Dr. A. P. West, professor of chemistry, University of the Philippines, who supplied me with hydrogenized lumbang, pili-nut, and chaulmoogra oils, I was enabled to carry out these experiments.

The results of this test prove experimentally the correctness of my supposition, at least so far as chaulmoogric acids are concerned. It can be seen from Table 3 that the original sample of chaulmoogra oil which was used for hydrogenization equaled the previously tested sample of "chaulmoogra, Japan" (see Table 1) in its growth-inhibiting activity. After five hours' hydrogenization the chaulmoogra oil still showed inhibition in 1 per cent and 0.5 per cent concentrations, while the sample hydrogenized for twenty hours gave only slight inhibition in 1 per cent concentration in agar; that is to say, a value of less than 1 as compared with the value 20 of the original sample.

With the hydrogenized pili-nut and lumbang oils, which were originally found to stimulate the growth of *Bacillus tuberculosis*, the results were not so striking as they were in the case of chaulmoogra oil, because the medium (glycerine meat broth agar) in which the oil was suspended is in itself sufficient for the growth of *B. tuberculosis*. Nevertheless, in the culture

tube to which pili-nut oil was added the growth was perceptibly more luxuriant at the end of one week of incubation than in the control tubes, while the culture tubes containing 1 per cent of hydrogenized pili-nut oil showed the same growth as the control tubes. The culture tubes containing fresh lumbang oil grew slightly better than did those containing hydrogenized lumbang oil, in which the growth was equal to that in the control culture tubes.

It had been noticed during the survey of vegetable oils<sup>13</sup> as to their growth-inhibiting action that certain oils added to glycerine meat infusion agar stimulate the growth of *Bacillus tuberculosis*. The objection may be raised that the judging of the difference of growth in the various culture tubes is subject to the personal equation. A more convincing and at the same time technically easy method was sought and, after several preliminary attempts, the following method was found to answer the purpose:

If the vegetable oils enter into the metabolism as food, which enables them to multiply, it was argued that the addition of such oils as were found noninhibitory might enable the acid-fast bacilli to grow on culture media on which they usually do not grow. Plain meat extract +1 acid agar was chosen, therefore, as a medium to which the oils mentioned above were added, and the mixture thoroughly shaken and quickly solidified in a slanted position. Plain meat extract +1 acid agar slants were taken as negative controls, while glycerine meat infusion +1 acid agar slants were simultaneously inoculated to see that the seed culture contained *Bacillus tuberculosis*, viable under favorable conditions. The results of these experiments are evident from Table 4. They show that certain vegetable oils or their components are taken up as food by acid-fast bacilli.

It is reasonable to believe that, in the process of assimilation, the bacteria themselves do not remain inactive. Evidence<sup>14</sup> is on hand that soluble lipase is formed in growing cultures of acid-fast bacteria. Vegetable oils are polyglycerides or glyceryl esters of higher and lower fatty acids. It remains therefore to find out whether the fatty acids themselves or the glyceryl part of the oils, or both, are taken up by the acid-fast

<sup>13</sup> Philip. Journ. Sci. 24 (1924) 23.

<sup>14</sup> Kendall, A. I., Walker, A. W., and Day, A. A., Journ. Inf. Dis. 15 (1914) 443.

bacteria. It is a well-known fact that glycerol stimulates the growth of acid-fast bacteria in artificial culture media.

In order to decide this question fatty acids of those oils which proved to supply sufficient food to acid-fast bacteria to enable them to grow on unfavorable culture media were added to plain meat extract + 1 acid agar and the culture tubes were inoculated with a young culture of *Bacillus tuberculosis* after thorough shaking and rapid cooling. High alcohols, as far as available, were included to see how far these chemicals are concerned in the metabolism of acid-fast bacteria. The results of these tests are tabulated in Table 5; they prove that the growth-stimulating power of certain vegetable oils is due to the glyceryl part of the oils, and not to the fatty acids which they contain.

The results of these experiments are very instructive, in as much as they show that the unsaturation of oils containing the specific fatty acids which have selective inhibiting effect in vitro on the growth of acid-fast bacteria is paramount. Complete saturation of the fatty acids by hydrogen rendered chaulmoogra oil biologically inert. The saturation of the acids from the chaulmoogra series, however, takes place on the hydrocarbon ring and produces changes in the structure of the ring itself (there is loss of optical rotation after hydrogenization). Therefore, the specific growth-inhibiting activity of the acids from the chaulmoogric series is bound to the structure of the hydrocarbon ring. The length of the side chain may influence the growth-inhibiting activity of the individual acids from the chaulmoogric series; but, if conclusions arrived at from the investigation of open-chain acids apply equally well to side chains of hydrocarbon rings, the length of the side chain (that is, the number of  $\text{CH}_2$  groups) should decrease rather than increase it. Furthermore, the length of the side chain may affect the solubility of the compound. It was noticed that the sodium salt of chaulmoogric acid ( $\text{C}_{18}\text{H}_{32}\text{O}_2$ ) gave a lower value than the sodium salt of the hydnocarpic acid ( $\text{C}_{16}\text{H}_{28}\text{O}_2$ ). The investigation as to the growth-inhibiting effect of open-chain organic acids shows that, with the increase in number of  $\text{CH}_2$  groups, the growth-inhibiting activity of the individual acids, tested in the form of slightly alkaline soap, decreases gradually, if not regularly, from formic acid down. One member of our collection, however, the cinnamic acid, possessing a double bond, stands out as the one giving the highest growth-inhibiting value of all the acids tested. This finding suggests

a similarity between the double-bonded structure of this acid and the structure of the hydrocarbon ring of the chaulmoogric acids.

Cinnamic acid ( $C_6H_5\ CH=CH\ COOH$ ) has a double bond, linking a carboxyl group on one side with a phenyl group on the other side by  $CH=CH$ . In the terms of the theory, the double-bonded group acts as a haptophore and the phenyl group as a toxophore group. The substitution of an H in the phenyl group by OH in oxycinnamic or cumaric acid lowers the growth-inhibiting activity from 100 to less than 1, although the haptophore group ( $CH=CH$ ) is present in cumaric as well as in cinnamic acid. On the other hand, the phenyl group (that is, the toxophore group) is represented in benzoic ( $C_6H_5\ COOH$ ) as well as in mandelic acids ( $C_6H_5\ CH(OH)\ COOH$ ), both of which nevertheless give a low growth-inhibiting value (about 1).

Similar conditions prevail in allyl alcohol and cinnamyl alcohol. Allyl alcohol ( $CH_2=CH\ CH_2\ OH$ ) is an unsaturated alcohol giving a growth-inhibiting value of 2. The introduction of the phenyl group in place of one H in  $CH_2$ , cinnamyl alcohol ( $C_6H_5\ CH=CH\ CH_2\ OH$ ), raises the growth-inhibiting value from 2 to 20.

On the other hand, crotonic acid ( $CH_3\ CH=CH\ COOH$ ) has the same haptophore group ( $CH=CH$ ), but the phenyl group is replaced by the methyl group which is responsible for the comparatively low growth-inhibiting value (less than 2).

Considering the great similarity in chemical structure of certain cyclic compounds, one can see that the double bond on the ring is present in the ineffective carvene as well as in the strongly effective carvone. On the other hand, the CO group, which makes the only difference between the carvene ring and the carvone ring, is present in pulegone also, but the latter lacks the double bond on the ring. We have to a certain extent in carvene, pulegone, and carvone a case analogous with that in oxycinnamic, benzoic, and cinnamic acids with regard to their structure and antiseptic effect.

These compounds (carvene, carvone, and pulegone) stand to each other with regard to their antiseptic activity as they do with regard to their physiological effect on the central nervous system and the motor-nerve terminals. According to L. Spiegel,<sup>15</sup>

<sup>15</sup> Chemical Constitution and Physiological Action, translated by C. Luedeking and Boylston (1915) 73 and 74.

The behavior of Thujone is similar to Camphor, but \* \* \* Carvone is a poison which has a violent cramp producing action, which may perhaps be attributed to the double bond in the ring. A reason for ascribing this action to the double bond is that such an effect does not occur \* \* \* for Pulegone,

which lacks the double bond in the ring.

The oils that stimulate the growth of acid-fast bacteria or, in other words, are taken up as food by the bacteria, behave similarly with regard to the relation between the unsaturation and their growth-stimulating activity as do those which inhibit the growth. Pili-nut oil, for example (iodine number 61.25) stimulates the growth of *Bacillus tuberculosis* to the same extent as does olive oil (iodine number 79 to 88), that is to say, much more than lumbang oil which is more highly unsaturated (iodine number 114 to 163) than either of the two other oils; but completely saturated lumbang, like pili-nut oil, has lost its growth-stimulating activity. Consequently, the degree of unsaturation is not the deciding factor, although the condition of unsaturation is essential. It appears that the oils must be unsaturated in order to enter into the metabolism of the bacteria, but it depends on the chemical structure whether or not the product of assimilation of the oils by the bacteria will be deleterious to the latter. The growth-stimulating effect is due to the glycerine part of the oil since, as has been already mentioned, the fatty acids separated from growth-stimulating oils proved to be without effect. (See Table 5.)

A phenomenon observed by Walker and Sweeney<sup>16</sup> in their tests of chaulmoogric preparations, that certain irregularities occurred in dilutions approaching the border line of inhibition, is of interest. Similar observations were made in my experiments where solid media were used. I noticed at times that single or few isolated colonies developed in culture tubes containing dilutions of chaulmoogric preparations which usually gave complete inhibition. These colonies did not spread widely over the surface of the culture medium as is customary with acid-fast bacilli, but their growth piled up vertically forming in due time cupolated moist colonies. Similar growth was observed on highly acid glycerine agar on the occasion of testing the reaction range of our particular strain, while toward the

<sup>16</sup> The chemotherapeutics of the chaulmoogric acid series and other fatty acids in leprosy and tuberculosis, Journ. Inf. Dis. 1 (1920) 1.

alkaline end of the scale of culture media the growth developed dry, spreading, and corrugated.

It occurred to me, naturally, that these isolated atypical colonies may represent what might be termed adaptation mutants, and I proceeded to transplant them on glycerine agar slants; some of the slants contained the same concentration of chaulmoogric preparations as the ones on which the so-called mutants occurred, others contained a lower concentration, and still others a higher concentration. The growth was slow in developing, so that transplants were made once or twice a month. The subculture which showed growth on the highest concentration was further transferred to glycerine beef agar containing the same amount of chaulmoogric salt, as well as to media containing a lower and a higher concentration thereof.

After eighteen months of a forced adaptation process the strain showed a tolerance to sodium gynocardate ten times higher than originally.

This observation seems to be of interest, since a similar phenomenon has been observed by others, using various nonacid-fast bacteria and chemicals like arsenic compounds and aniline dyes, which substances enter into direct chemical combination with bacterial substances. May not this phenomenon explain, in part at least, the clinical experience that leprosy in patients receiving chaulmoogra treatment after initial improvement becomes stationary?

The following abbreviations are used in Tables 1, 3, 4, and 5:

+, growth as good as control.

-, no growth.

+inh, growth scanty, compared with control.

#### CONCLUSIONS

1. The degree of unsaturation of vegetable oils which stimulate the growth of acid-fast bacteria and of those which inhibit the growth of acid-fast bacteria has no relation to their growth-stimulating or growth-inhibiting activity.

2. The growth-stimulating effect of certain vegetable oils is due to the glyceryl and not to the acid part of the oil.

3. The condition of unsaturation of the oils containing the acids from the chaulmoogra series and of the oils which stimulate the growth of acid-fast bacteria is paramount.

4. Saturated chaulmoogra oil lacks the growth-inhibiting activity toward acid-fast bacteria which is possessed by the unsaturated oil.

5. The growth-inhibiting activity of chaulmoogra oil depends on the structure of the ring of the fatty acids. When the structure of the ring is changed by saturation with hydrogen the oil loses this biologic property.

6. There are indications that, due to physical properties, acids from the chaulmoogric series containing a short side chain are more effective in vitro than are those having a long side chain.

7. Acid-fast bacteria adapt themselves to the acids from the chaulmoogric series in due time and then withstand larger doses than they did originally.

TABLE 1.—*Showing the different nature of the growth-inhibiting action of chaulmoogra and volatile oils.*

Name of oil.	Growth-inhibiting effect by direct contact with <i>Bacillus tuberculosi</i> .	Growth-inhibiting effect of vapors upon <i>Bacillus tuberculosis</i> .
Chaulmoogra, India.....	—	+
Chaulmoogra, Japan.....	—	+
<i>Hydnocarpus wightiana</i> .....	—	+
<i>Hydnocarpus alcalo</i> .....	—	+
<i>Hydnocarpus venenata</i> .....	—	+
<i>Hydnocarpus subfalcata</i> .....	—	+
<i>Gynocardia odorata</i> .....	+	+
Bergamot.....	—	—
Cashew.....	—	+
<i>Caryophyllum</i> .....	—	—
Cedar.....	—	+inh
Cinnamon.....	—	—
<i>Citrus microcarpus</i> .....	—	—
<i>Dacrydium</i> .....	—	—
Eucalyptol.....	—	—
Palomaria.....	—	—
Palomaria resin.....	—	+
<i>Pinus sylvestris</i> .....	—	+
Vetiver.....	—	+inh

TABLE 2.—*Showing the relation between the degree of unsaturation and the growth-inhibiting action of vegetable oils.*

Name of oil.	Iodine number (Lewko-witsch).	Growth-inhibiting titer.	Growth-inhibiting value.
Linseed.....	173-201	0	0
Cedar.....	159.2	0.1	1
<i>Gynocardiae odoratæ</i> .....	152.8	0	0
Maize.....	111-130	0	0
Kapok.....	116-117.9	0	0
Sesame.....	103-108	0	0
Olive.....	79-88	0	0
Castor.....	88-90	0	0
Cod liver.....	154.5-181.3	0	0
Chaulmoogra.....	90.7-104	0.005	20
Margosa.....	69.6	0	0
Palm.....	51.5-57	0	0
Coconut.....	8-10	0.1	1
Peanut.....	92-100.8	0.1	1
Pili-nut.....	61.25	0	0
Lumbang.....	114.2-163.7	0	0
Bagilumbang.....	158.5-166	0.1	1
Cashew.....	84	0.01	10
Shark liver.....	114.6	0	0

TABLE 3.—Showing the results of growth-inhibiting tests with saturated and unsaturated chaulmoogra oil and its derivatives.

Medium used, glycerine agar, to which was added 0.1 cubic centimeter of—	Growth in four weeks.	Value.
Chaulmoogra oil, original.....	—	20
Chaulmoogra oil, hydrogenated 5 hours.....	+	2
Chaulmoogra oil, hydrogenated 20 hours.....	+	< 1
Chaulmoogra oil, iodine partially saturated.....	—	20
Chaulmoogra oil, iodine completely saturated by Hanus method.....	+	< 1
Gynocardate A 3 per cent, original.....	—	20
Gynocardate, iodine partially saturated.....	—	20

TABLE 4.—Showing the growth-stimulating effect of certain vegetable oils and alcohols.

Name of oil added to plain meat extract + 1 acid agar.	Amount added to 10 cubic centimeters of plain agar	Growth of <i>Bacillus tuberculosis</i> .	
		Two weeks.	Four weeks.
Avocado.....	cc.	—	—
Bayavac.....	0.1	—	—
Betis.....	0.1	—	—
Calamis.....	0.1	+	+
Castor.....	0.1	+	+
Coconut.....	0.1	—	—
Camachili.....	0.1	—	—
Kalumpang.....	0.1	+	+
Kapok.....	0.1	—	—
Linseed.....	0.1	—	—
Lumbang.....	0.1	+	+
Lumbang, hydrogenized.....	0.1	—	—
Maize.....	0.1	+	+
Olive.....	0.1	+	+
Palomaria.....	0.1	—	—
Peanut.....	0.1	—	—
Petroleum nut.....	0.1	—	—
Pili-nut.....	0.1	+	+
Pili-nut, hydrogenized.....	0.1	—	—
Sesamum.....	0.1	—	—
Shark liver.....	0.1	—	—
Sincamas.....	0.1	—	—
<i>Gynocardia odorata</i> .....	0.1	—	—
Glycerine agar, control.....	0.5	+	+
Plain agar, control.....	2	—	—

TABLE 5.—*Showing the results of growth-stimulating tests with alcohols and organic acids, including acids separated from vegetable oils which stimulate the growth of acid-fast bacilli.*

Name of alcohol or acid.	Amount added to 10 cubic centime- ters of plain agar.	Growth af- ter four weeks in- cubation.
	cc.	
Heptyl alcohol.....	0.1	—
Octyl alcohol, normal.....	0.1	—
Octyl alcohol, secondary.....	0.1	—
Melissyl alcohol.....	0.1	—
Cetyl alcohol.....	0.1	—
Piperonyl alcohol.....	0.1	—
Oleic acid.....	0.1	—
Oxalic acid.....	0.1	—
Succinic acid.....	0.1	—
Citric acid.....	0.1	—
Hydrochinamic acid.....	0.1	—
Cumaric acid.....	0.1	—
Terephthalic acid.....	0.1	—
Uric acid.....	0.1	—
Camphoric acid.....	0.1	—
Total fatty acids of castor oil.....	0.1	—
Total fatty acids of olive oil.....	0.1	—
Total fatty acids of lumbang oil.....	0.1	—

## DETECTION OF TRACES OF ALKALI OR SOAP IN REFINED COCONUT OIL

By WALTER L. BROOKE

*Chemist, Bureau of Science, Manila*

In the manufacture of oleomargarine from refined coconut oil, considerable difficulty was experienced because the butter substitute, a short time after manufacture, developed a sharp soapy taste. In attempting to locate the cause of this trouble, it was thought that perhaps the small amount of sodium carbonate in the caustic soda that was used to refine the crude oil failed to combine with the free fatty acids or failed to saponify the esters in the time and at the temperature at which the refining was performed. A slight excess of caustic solution was always used over and above that actually needed to neutralize the free fatty acids which a control analysis showed to be present.

Sodium carbonate was thought to be the cause of the soapy taste because—

1. After neutralization in refining, the oil was held at high vacuum for a considerable time, so that the soap would become anhydrous and be precipitated from the dry oil.
2. The soapy taste in the butter only developed several days or a week after the butter had been made.
3. A comparative saponification experiment with sodium hydroxide and sodium carbonate indicated that with sodium carbonate the rate of saponification of coconut oil is much less than with sodium hydroxide.

In view of the facts, it became important that a laboratory method of detecting small amounts of carbonate or alkali in the refined oil be available. The only methods with which I was familiar were those of Marcusson<sup>1</sup> and of Siepel,<sup>2</sup> both of which are based on the insolubility of soap in acetone. Siepel states that the best way to detect soap in oils is by ashing.

<sup>1</sup> Eighth Int. Congr. of Applied Chem. 25 (1912) 777.

<sup>2</sup> Seifensieder Ztg. 40: 199.

It was decided to run a few ignition experiments to determine the sensitivity of this ashing method of detecting soap or alkali in oils. The oil used was a refined coconut oil which was washed three times with hot distilled water to make sure that it contained no soap or alkali. Twenty-five grams of the oil were weighed in a nickel crucible and then varying amounts of sodium carbonate were added, the oil burned, first, by keeping the flame of a Bunsen burner in contact with its surface and, later, by putting it in a Muffle furnace and bringing it to a red heat. If the oil was heated with a flame until it burned without a Bunsen burner as a pilot light, great quantities of soot would be produced. The development of a pink color upon the addition of a few cubic centimeters of distilled water and a drop of phenolphthalein was considered sufficient evidence of the presence of alkali or soap in the oil. Anhydrous chemically pure sodium carbonate was used in these experiments. The results are shown in Table 1.

TABLE 1.

Experiment	1	2	3	4	5
Oil.....grams.....	25.0	25.0	25.0	25.0	25.0
Sodium carbonate.....do.....	0.0	0.0118	0.0090	0.0052	0.0046
Reaction to phenolphthalein.....		Pink.	Pink.	Pink.	Pink.
Sodium carbonate.....per cent.....	0.0	0.047	0.036	0.0208	0.0184

Because the error introduced in weighing such small amounts of substance would be considerable, it was decided to use a solution. An aqueous solution could not be used as it caused sputtering in the burning of the oil. Sodium ethylate (made by dissolving solid sodium hydroxide in absolute alcohol) proved to be the most convenient way of introducing the alkali. The strength of the ethylate was determined by titration against a standard acid solution. The experimental results are recorded in Table 2.

TABLE 2.

Experiment	1	2	3
Oil.....grams.....	25.0	25.0	25.0
Ethylate.....cc.....	5.0	2.0	1.0
Equivalent sodium hydroxide.....grams.....	0.0014	0.00057	0.00028
Phenolphthalein reaction.....	Pink.	Pink.	Pink.
Sodium hydroxide.....per cent.....	0.005	0.0023	0.0011

A more dilute solution of alcoholate was now made by diluting some of the former ethylate solution with absolute alcohol (see Table 3).

TABLE 3.

Experiment		1	2	3
Oil.....	grams	25.0	25.0	25.0
Ethylate.....	cc.	1.0	0.75	0.5
Sodium hydroxide.....	grams	0.000162	0.000121	0.000081
Reaction to phenolphthalein.....		Pink.	Pink.	Pale pink.
Sodium hydroxide.....	per cent	0.00065	0.00048	0.00033

All of these experiments were done in duplicate and the results agreed in all cases. In the tests recorded in Table 3, the phenolphthalein color began to be lighter than in those recorded in Table 1. In experiment 3 it was still visible, although much lighter than the color of experiment 1.

In these experiments a nickel crucible was found to be better than a porcelain one, because the temperature that was required to decolorize the charred residue was sufficient partly to fuse the glazed surface on the porcelain crucible. The removal of the last traces of alkali from such a partly fused surface is very difficult.

#### CONCLUSIONS

1. Less than 0.02 per cent sodium carbonate can be detected in 25 grams of coconut oil by ashing and testing with phenolphthalein.
2. As small an amount as 0.00065 per cent sodium hydroxide can be detected in 25 grams of coconut oil with certainty by ashing.
3. A nickel crucible is preferable to a porcelain crucible for ashing.



A TOOTH OF A FOSSIL SHARK FROM TAMBARON  
ISLAND, NEAR SOUTHERN MINDORO

By A. N. KRYSHTAFOVICH

*Of the Geological Survey of Russia, Vladivostok*

ONE PLATE

*Carcharodon arnoldi* JORDAN. Plate 1.

*Carcharodon* sp., MURRAY, Rep. Challenger Exped., Deep Sea Deposits (1891) 269, pl. 5, figs. 3 and 4.

*Carcharodon megalodon* ISHIWARA.<sup>1</sup>

*Carcharodon arnoldi* JORDAN, Univ. Cal. Publ., Bull. Dept. Geol. 5 (1907) 113, fig. 13; JORDAN and BEAL, Univ. Cal. Publ., Bull. Dept. Geol. 7 (1913) 252; ISHIWARA, Sci. Rep. Tohoku Imp. Univ. II Geology, No. 3, 5 (1920) 67 (7), pl. 12 (III), figs. 3, 4.

Locality, western coast of the southern point of Tambaron Island, southern Mindoro, in Bulalacao Bay; probable Vigo group.

The tooth under consideration was found by Mr. G. B. Moody in the conglomerate dipping at a moderate angle to the southwest. The length of the tooth is 6.2+ centimeters and the width at the base, 5.6+ centimeters; the maximum thickness of the crown, 1 centimeter. The edges of the crown are, as usual, minutely serrated, about 60 serræ on each side.

*Carcharodon arnoldi* differs from *C. megalodon* by the less numerous, coarser, and more acutely pointed serræ than in *C. megalodon*, but they are more numerous, finer, and blunter than in existing *C. carcharias*; similar teeth, described from Japan, possess about 65 or more serræ on each side of the crown (preserved specimens have only 50 to 52).

The shape of this tooth is flatly and acutely conical, less broad at the base than usual for *Carcharodon megalodon*. The inner surface is moderately convex; the outer, slightly convex. Ishiwara is of opinion that *C. arnoldi* is really an extinct species, intermediary between extinct *C. megalodon* and the still existing *C. carcharias* (Linn.). This opinion is opposed to the view of Leriche, who pointed out that *C. arnoldi* and *C. riversi* are identical with the living *C. carcharias*. However, Jordan and Beal are not inclined to adhere to Leriche's opinion. Ishiwara thinks

<sup>1</sup> Date and place of publication not known.

that, though *C. riversi* is overlapped by the characters of existing *C. carcharias*, the tooth of *C. arnoldi* represents apparently a separate species, because the largest teeth of *C. carcharodon* possess only 46 to 48 serræ, while the serræ of *C. arnoldi* number 60 and more (*C. megalodon* has over 100 serræ).

*Carcharodon arnoldi* has been found hitherto in the following localities:

South Pacific Ocean at a depth of 2,385 fathoms, by Challenger Expedition.

Burma, Pegu shales, at Padaukpin (sub *C. megalodon*).

California, in Pliocene and Quaternary strata.

Japan, at Shimoda, Idzu Province, and at Iruma, Sagami Province.

To this list we now add Tambaron Island, in Bulalacao Bay, southern Mindoro, Philippine Islands, probably in the deposits of Vigo group (Lower Miocene?).

The larger and more abundantly serrated teeth of *Carcharodon megalodon* have been found in numerous localities of Europe and America, in the strata since Eocene to Pliocene age, as well as in the following several localities of Japan:

Miocene (?):

Nagakubo, Mutsu Province.

Yumachi, Idzumo.

Ashiarai and Otsu, Hitachi Province.

Togari, Mino Province.

Neogene:

Dzushi, Uraga, Yokosuka, Sagami Province.

Nokogiri, Akasaki, Awa Province.

Mito, Hitachi Province.

Shimojo, Usuda, Shinano Province.

Nagasaki, Mino Province.

Hiuchidani, Hannoura, Noto Province.

Torawa, Ugo Province.

Kachimadai, Kanagase and environs of Sendai, Rikuzen Province.

Hokkaido:

Hatsune mines, Futorogori, Shiribeshi Province.

Meppu mines, Setunai gori, Shiribeshi Province.

## ILLUSTRATION

PLATE 1. *Carcharodon arnoldi* Jordan; from photographs of a tooth collected on Tambaron Island, Bulalacao Bay, Mindoro.



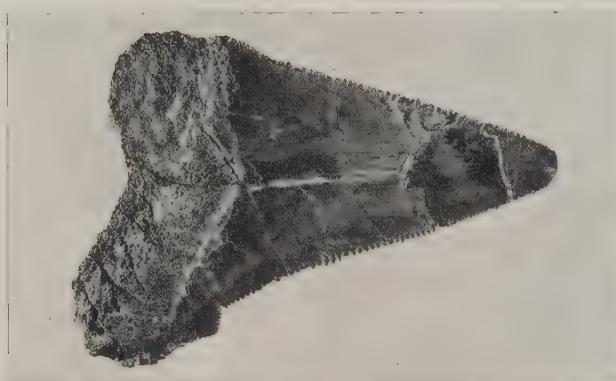


PLATE 1. A TOOTH OF CARCHARODON ARNOLDI JORDAN.



## CLASSIFICATION OF THE PHILIPPINE COMPONENTS OF THE COLEOPTEROUS FAMILY CLERIDÆ

By EDWARD A. CHAPIN

*Of the United States Department of Agriculture, Washington, D. C.*

### FIVE PLATES

When we review the great questions arising out of the geographical distribution of animals and plants, there can be no doubt whatsoever that the close investigation of any given area, however minute, must contribute materially, provided its position be a significant one, to lighten the labours of those more comprehensive naturalists who are able to wield, with a master's hand, the scanty data gleaned by the humbler workers in the science, to a practical account. And, since it has been said that whatsoever falls within the sphere of knowledge is attached to a radius and tends towards the centre, there is reason to hope that no amount of truth, once fairly arrived at, will be eventually lost; but that it will sooner or later find its way into the central mass, to be employed, whenever chance may require it, for the general good. Hence it is that we are encouraged, in every branch of observation, to register what we see; and to feel that the most trivial facts, if faithfully recorded, may become the basis from whence the soundest theories may arise—such theories farsooth as have already arisen from the contemplation of circumstances apparently beneath our notice, and which have grown up, step by step, into trees of gigantic dimensions, to embrace at last large principles within their shade.—*T. Vernon Wollaston.*

### HISTORICAL

Until Prof. C. F. Baker commenced his work in the Philippines, there had been no systematic collecting on a large scale of the insect fauna, with the result that there have been, up to the present, very few species of Cleridæ described from that Archipelago. *Thaneroclerus buqueti* (Lef.), 1835, an insect of considerable economic importance to the tobacco industry, appears to be the first species to be made known from the Islands. Between 1835 and 1876 Chevrolat described two species, one of which was made the type of the genus *Cladiscus*; the other, *Tenerus philippinarum*, if the measurements given in the description are correct, will prove to be a most aberrant species of its genus. In 1876 Gorham started a series of papers on the Cleridæ of the world. The first of the series appeared in *Cistula Entomologica*. The remaining three papers were published

in the Transactions of the Entomological Society of London for 1877 and 1878. In this series Gorham lists twenty-three species of Cleridæ which were collected, mainly on Mindanao and Luzon, by Semper. Of these, seventeen are described as new. During the same year Waterhouse erected the genus *Sisyrnophorus* to contain *maculatus*, a new species. Since then this genus has been suppressed in favor of *Allochotes* Westw. Between 1878 and the present only a few species have been added to the Philippine list. Two species were made known by Schenkling in 1913, eleven by Chapin in 1919 and 1922, and six by Heller in 1921.

#### ZOOGEOGRAPHY

The zoogeographic provinces of the Philippine Islands have been worked out, from the standpoint of the avifauna, by McGregor. While at present nothing is known of the clerid fauna of many of the islands, and very little of others, still it is interesting to note that in general the distribution of the Cleridæ by faunal regions coincides to a very pleasing degree with McGregor's findings. For instance, the two known species from Palawan have marked Bornean affinities, *Callimerus fenestratus* Chpn. is close to *C. bellus* Gorh., and *Dasyceroclerus banksi* Schklg. is not only closely related to *D. cylindricus* (Westw.) but is also the only representative of the genus known from the Philippines. There is only one point in which the results of this study conflict with McGregor's; Basilan is apparently not sharply separated from Mindanao in regard to fauna; at least, the differences between Palawan and Mindanao are much greater than between Basilan and Mindanao. If Palawan and Mindanao are accepted as divisions of equal rank, Basilan should be designated as a subdivision of Mindanao.

#### SCHEME OF CLASSIFICATION

The system adopted in this work is essentially that of Schenkling (1903), in that the six subfamilies outlined by him are, with some modifications, put into use. The classification of the family into two subfamilies and six tribes, which was developed by Lacordaire and utilized more or less continuously since his time, is not followed, because a study of the species of the world shows too many instances where it is impossible to classify the insect according to this system without violating its

natural affinities. By the erection of one new subfamily which combines characters supposed to pertain to the first subfamily of Lacordaire with characters of fundamental importance in the second, and by the elevation of Lacordaire's tribes to subfamily rank, it is believed that a more logical and natural system, so far as our present knowledge is concerned, is produced.

Although the subfamilies used in this work correspond practically to the tribes of Schenkling (1910) the characters used to separate them are in part different, resulting in some interchange of genera. For instance, instead of placing in the Tillinæ all species whose tarsi are composed of five well-developed segments, regardless of their other characters, the structure of the thorax is considered. *Callimerus* Gorh. in every character except its tarsi is hydnocerine; in the present system it finds its place there without difficulty. *Thaneroclerus* Lef. is withdrawn from the Clerinæ and becomes the type of a new subfamily, the Thaneroclerinæ. Other genera remain as they were assigned by Schenkling. The subfamilies themselves are arranged in a slightly different order to conform to my views regarding their relations.

#### TILLINÆ

##### Genus CYLIDRUS Latreille

1. *cyaneus* (Fabr.).

##### Genus CLADISCUS Chevrolat

2. <i>bacillus</i> Heller.	6. <i>mindanensis</i> sp. nov.
3. <i>bakeri</i> sp. nov.	7. <i>strangulatus</i> Chevr.
4. <i>bicolor</i> sp. nov.	8. <i>vicinus</i> sp. nov.
5. <i>clypealis</i> sp. nov.	

##### Genus DIPLOPHERUSA Heller

9. *tumidipes* Heller.

##### Genus CYLIDROCTENUS Kraatz

10. *chalybeus* (Westw.).

##### Genus TILLUS Olivier

11. <i>bifasciellus</i> White.	13. <i>mindanensis</i> Chpn.
12. <i>carinatulus</i> Schklg.	14. <i>notatus</i> Klug.

##### Genus GASTROCENTRUM Gorham

15. *unicolor* (White).

## HYDNOCERINÆ

## Genus NEOHYDNUS Gorham

16. <i>ater</i> sp. nov.	23. <i>luzonicus</i> sp. nov.
17. <i>attalus</i> sp. nov.	24. <i>pictus</i> sp. nov.
18. <i>auripilosus</i> sp. nov.	25. <i>pilosus</i> sp. nov.
19. <i>bakeri</i> sp. nov.	26. <i>scutellatus</i> sp. nov.
20. <i>colon</i> sp. nov.	27. <i>sexnotatus</i> sp. nov.
21. <i>constrictus</i> sp. nov.	28. <i>tibialis</i> sp. nov.
22. <i>granulatus</i> sp. nov.	

## Genus BRACHYCALLIMERUS novum

29. *latifrons* (Gorh.).

## Genus CALLIMERUS Gorham

30. <i>albescens</i> Chpn.	39. <i>lateralis</i> Chpn.
31. <i>albus</i> Chpn.	40. <i>luzonicus</i> Chpn.
32. <i>bakeri</i> Chpn.	41. <i>octopunctatus</i> Heller.
33. <i>basilanicus</i> Chpn.	42. <i>persimilis</i> Chpn.
34. <i>bisoctonotatus</i> sp. nov.	43. <i>princeps</i> Chpn.
35. <i>fenestratus</i> Chpn.	44. <i>pulchellus</i> Gorh.
36. <i>flavus</i> Chpn.	45. <i>schultzei</i> Schkdg.
37. <i>gratiosus</i> Gorh.	46. <i>trifoliatus</i> sp. nov.
38. <i>intermedius</i> sp. nov.	

## CLERINÆ

## Genus NOTOXUS Fabricius

## Genus ANTHICOCLERUS Schenckling

47. *anthicoides* (Westw.).

## Genus ORTHRIUS Gorham

48. <i>bicrucis</i> sp. nov.	50. <i>pallidus</i> sp. nov.
49. <i>binotatus</i> Fisch.	

## Genus PSEUDOMADIUS novum

51. *viridiventris* sp. nov.

## Genus OMADIUS Castelnau

52. <i>aurifasciatus</i> Gorh.	58. <i>nimbifer</i> Gorh.
53. <i>aurulentus</i> Heller.	59. <i>notatus</i> Gorh.
54. <i>bakeri</i> Heller.	60. <i>posticalis</i> Gorh.
55. <i>brunneus</i> sp. nov.	61. <i>pruinosus</i> sp. nov.
56. <i>centralis</i> (Gorh.).	62. <i>sibuyanus</i> sp. nov.
57. <i>kamelianus</i> White.	63. <i>vespiformis</i> Gorh.

## Genus OPERCULIPHORUS Kuwert

64. *philippinus* sp. nov.

## Genus RHYTIDOCLERUS Kuwert

65. *subfuscus* (Gorh.).

Genus **DASYCEROCLERUS** Kuwert66. *banksi* Schkllg.Genus **THALEROCNEMIS** Lohde67. *bakeri* sp. nov.68. *variabilis* sp. nov.Genus **PHAEOCYCLOTOMUS** Kuwert69. *nigripes* sp. nov.70. *tapetum* (Gorh.).Genus **STIGMATIUM** Gray71. *bakeri* sp. nov.74. *philippinarum* Gorh.72. *encaustum* Gorh.75. *sibuyanum* sp. nov.73. *laterifoveatum* Kuw.76. *tuberculibase* Kuw.Genus **COPTOCLERUS** novum77. *albipictus* sp. nov.82. *obliquus* sp. nov.78. *apicalis* sp. nov.83. *sericeus* sp. nov.79. *binotatus* sp. nov.84. *triangularis* sp. nov.80. *fasciatus* sp. nov.85. *variegatus* sp. nov.81. *intricatus* sp. nov.

## THANEROCLERINÆ

Genus **THANEROCLERUS** Lefebvre86. *buqueti* Lef.Genus **CYRTINOCLERUS** novum87. *cyrtinoides* sp. nov.

## ENOPLIINÆ

Genus **ALLOCHOTES** Westwood88. *bakeri* sp. nov.90. *pallidus* sp. nov.89. *maculatus* (Waterh.).Genus **TENERUS** Castelnau91. *acostatus* sp. nov.98. *obscurus* sp. nov.92. *basilanicus* sp. nov.99. *philippinarum* Chevr.93. *cyanopterus* Spin.100. *pulcher* sp. nov.94. *luzonicus* sp. nov.101. *sibuyanus* sp. nov.95. *magnus* sp. nov.102. *signaticollis* Cast.96. *mindanaonicus* Gorh.103. *trinotatus* sp. nov.97. *nigripes* sp. nov.104. *vittiger* sp. nov.Genus **TENEROIDES** Gahan105. *aurantiacus* sp. nov.107. *melanopterus* sp. nov.106. *bakeri* sp. nov.108. *tuberculatus* sp. nov.Genus **PARATENERUS** novum109. *mindanensis* sp. nov.

Genus **TENEROPSIS** novum110. *sibuyanus* sp. nov.

## KORYNETINÆ

Genus **TARSOSTENUS** Spinola111. *univittatus* Rossi.Genus **NECROBIA** Olivier112. *ruficollis* (Fabr.).113. *rufipes* DeG.

## TAXONOMY

## CLERIDÆ

*Family characters.*—Coleoptera genuina, pentamera. Head prominent; eyes usually conspicuously emarginate; antennæ of eight to eleven segments, serrate, clavate or capitate; labrum corneous, usually emarginate; mandibles stout, with one or more internal teeth; maxillæ with two lobes, maxillary palp with terminal segment cylindrical to broadly triangular; labium small, labial palp with terminal segment usually triangular, sometimes cylindrical; gular sutures parallel, convergent anteriorly or convergent posteriorly. Thorax with or without a well-developed cariniform margin; anterior coxal cavities open, or closed by the complete junction of the internal muscle plates; mesosternum usually normal, sometimes vertical anteriorly; medial coxal cavities approximate; metasternum longer than either pro- or mesosternum; posterior coxal cavities narrowly separated. Scutellum small, always visible. Elytra of firm texture, usually covering the abdomen, in one subfamily (Hydnocerinae) often abbreviated, abdomen with five or six visible sternites, corneous, often with coriaceous posterior margins, often some of the segments with secondary sexual modifications. Legs of normal form, posterior trochanters in one genus at least (*Teneroides* Gahan) modified in the male, tarsi with all segments distinct or with the first reduced in size or the fourth reduced, or both the first and fourth reduced, second and third and sometimes first or fourth with a lamella on the underside. Fifth segment longer than the fourth, claws simple, or with a basal platelike tooth or with a basal and median internal tooth.

The family Cleridæ is distributed over the entire world and exhibits a greater diversity of form than any other coleopterous family. Many genera show marked resemblance to genera of other families, such as the Lycidæ, Telephoridæ, Cerambycidæ, and Coccinellidæ.

For convenience I have included all the known subfamilies in the following key, although the subfamily Epiphloeinæ is not represented in the region under discussion:

*Key to the known subfamilies of the Cleridæ.*

1. Fourth segment of tarsus approximately equal in size to third..... 2.  
Fourth segment of tarsus small, usually indistinct, embedded between the lobes of the third..... 5.
2. Anterior coxal cavities completely closed externally and internally; first tarsal segment distinctly visible from above..... *Tillinæ.*  
Anterior coxal cavities always open internally, usually so externally.. 3.
3. Anterior tarsi broadly dilated, tarsal segments short and compact; eyes nearly entire; thoracic punctures elongate-oval, not circular.  
*Thaneroclerinæ.*  
Anterior tarsi of usual form; eyes usually distinctly emarginate; thoracic punctures circular..... 4.
4. Eyes deeply emarginate; first tarsal segment small, covered by the second ..... *Clerinæ.*  
Eyes entire or virtually so, first tarsal segment variable.... *Hydnocerinæ.*
5. Anterior tibiæ spinulose, thorax with a pair of discal and a pair of lateral sensory setæ, eyes emarginate internally..... *Epiphloeinæ.*  
Anterior tibiæ not spinulose, sometimes finely serrate, thorax without sensory setæ, eyes emarginate anteriorly..... 6.
6. Antennæ serrate or with the terminal three segments long, forming a lax club, this club about as long as the preceding segments together.  
*Enopliinæ.*  
Antennæ with a short compact club of three segments which is always shorter than the rest of the organ..... *Korynetinæ.*

#### TILLINÆ

*Subfamily characters.*—Cleridæ; head large or medium sized, eyes emarginate, antennæ eleven-segmented, serrate, flabellate or with a more or less well developed club, terminal segments of maxillary and labial palpi variable. Thorax with the anterior coxal cavities completely closed both externally and by the internal muscle-attachment plates. Elytra covering or almost covering the abdomen. Abdomen with six visible ventral segments. Tarsi with both the first and fourth segments well developed and visible from above. Tarsal claws usually with broad basal tooth and with a second sharp tooth internally, arising just beyond the basal.

Of the above-mentioned characters, the two which appear to me to be of greatest value are (*a*) the complete closing both externally and internally of the anterior coxal cavities and (*b*) the tripartite claws. I have been unable to find either of these characters in any genus not obviously tilline and it may be that such genera as *Diplophorus* Fairm. and *Diplopherus* Heller

should be joined with *Axina* Kirby and *Priocera* Kirby, both of which have the first and fourth tarsal segments well developed, to form a group within the next subfamily. For the present, however, *Diplophherusa* Heller is considered as belonging to this subfamily. The Philippine tilline genera are distinguished by the following key:

*Key to Philippine genera of Tillinæ.*

1. Antennæ with a more or less distinct, four-segmented club.  
Gastrocentrum Gorham.  
Antennæ strongly serrate or flabellate from the third segment..... 2.
2. Head large, labrum concealed, epistoma denticulate.. *Cylidrus* Latreille.  
Head smaller, labrum visible, epistoma not denticulate..... 3.
3. Terminal segment of labial palp elongate, subcylindric, antennæ biramose.  
*Diplophherusa* Heller.  
Terminal segment of labial palp cultriform or securiform..... 4.
4. Form very elongate, basal third of thorax very strongly strangulate.  
*Cladiscus* Chevrolat.  
Form cylindric, not very elongate, thorax constricted only at extreme base ..... 5.
5. Thorax broadly dilated at middle, anterior transverse impression of thorax distinct, labrum feebly emarginate..... *Cylidroctenus* Kraatz.  
Thorax with sides parallel, anterior transverse impression indistinct, labrum entire..... *Tillus* Olivier.

I have not seen specimens of *Diplophherusa* Heller, the characters used in the above key being taken from the original description. The genera *Tillus* Oliv. and *Cylidroctenus* Kraatz are rather close together and possibly do not deserve to be separated.

**Genus CYLIDRUS** Latreille

*Cylidrus* LATREILLE Cuv. Reg. Anim. 4 (1829) (Crust., Arachn., Ins.) 476; SPINOLA, Monog. Clérites 1 (1844) 82; LACORDAIRE, Gen. Col. 4 (1857) 424; SCHENKLING, Gen. Ins. (Wytsman) Cleridae Fasc. 13 (1903) 5, Deutsche Ent. Zeit. (1906) 243.

*Epiteles* NEWMAN, Entomol. (1842) 403.

*Generic characters.*—Tillinæ; head prognathous, labrum deeply bilobed, epistoma emarginate, usually with five denticles. Mandibles stout, conical, with short internal teeth near base, terminal segment of maxillary palp elongate, cylindrical, somewhat enlarged at middle, that of labial palp long, slender, slightly curved, eyes moderately coarsely granulated, emarginate, not prominent. Antennæ eleven-segmented, segment 1 stout, somewhat bent, segments 2 to 4 slender, cylindrical, segments 5 to 11 broad and flat, trapezoidal. Thorax longer than broad, cylindrical, anterior coxal cavities closed. Elytra long, nearly covering body. Abdomen with six visible ventral segments,

secondary sexual modifications slight. Femora greatly enlarged, legs moderately short, tarsi with five segments, the first easily seen from above, second to fourth short, together but slightly longer than fifth. Claws large, with accessory tooth between basal process and apex.

Genotype, *Cylidrus cyaneus* (Fabr.).

The genus is distributed over the Ethiopian, Oriental, and Australian Regions, with one species reported from the Neotropical Region. One species is found in the Philippine Islands. It may be distinguished by the following characters:

*Cylidrus cyaneus* (Fabr.).

*Clerus cyaneus* FABRICIUS, Mant. Ins. (1787) 126; SPINOLA, Monog. Clérates 1 (1844) 85, pl. 1, fig. 3.

Head long, very rough, sparsely pubescent, the hairs arising from elongate flattened tubercles, median longitudinal line on frons smooth, postocular carina sharp and distinct, supra-mandibular carina short and high, eyes long and narrow, vertical, rather finely granulate. Thorax with the anterior portion narrowly but very strongly reticulate, disk smooth with few punctures, sides somewhat roughened and more densely hairy. Visible portion of scutellum nearly circular. Elytra broadest at about middle, very finely punctured, sparsely pubescent, lateral margin strongly beaded, suture without bead; elytra overlap toward apex. Underparts smooth, sparsely punctured; tibiæ more coarsely punctured. Upper parts metallic blue, abdomen and legs reddish testaceous. Length, 8 to 8.5 millimeters.

Luzon, Laguna Province, Los Baños, and Mount Maquiling (Baker 253). Collected on dead *Cyathocalyx globosa*.

This is a very widely distributed species, reported from most parts of the Malay Archipelago, Madagascar, and Africa.

#### Genus CLADISCUS Chevrolat

*Cladiscus* CHEVROLAT, Ann. Soc. Ent. France (2) 1 (1843) 33; LACORDAIRE, Gen. Col. 4 (1857) 427; SCHENKLING, Gen. Ins. (Wytzman) Cleridae, Fasc. 13 (1903) 10.

Generic characters.—Tillinæ; head hypognathous, labrum slightly emarginate or straight, epistoma variable, mandibles short and stout, with accessory tooth near apex, terminal segment of maxillary palp cylindrical, slightly thickened near middle, that of labial palp elongate-cultriform, eyes coarsely granulate, emarginate, prominent. Antennæ eleven-segmented, serrate or flabellate, first segment stout, second nearly spher-

ical, segments 3 to 10 either broadly triangular or narrow with long basal rami (in some exotic species the segments are biramose), eleventh segment elongate-oval or diamond-shaped. Thorax campanulate, at the base very strongly constricted, anterior coxal cavities closed. Elytra long, parallel, covering the abdomen. Abdomen with six visible ventral segments, the first longer than any of the others, secondary sexual modifications slight. Legs long and slender, tarsi with five segments, the first easily visible from above, fifth about as long as third and fourth together. Claws large, the internal tooth almost as long as apical portion of claw.

Genotype, *Cladiscus strangulatus* Chevr.

A genus of twenty-nine species, mainly found in the Oriental Region, though representatives have been taken in Madagascar and Africa. The material before me may be separated into seven species, of which five are as yet undescribed. The following key emphasizes the specific differences:

*Key to species of Cladiscus Chevrolat.*

1. Antennæ flabellate.....	2.
Antennæ serrate.....	5.
2. Clypeo-frontal suture sinuate.....	3.
Clypeo-frontal suture evenly curved, convexity anterior.....	4.
3. Disk of thorax very sparsely punctured; anterior margin of clypeus straight, extending between bases of mandibles; 10 millimeters.	
C. strangulatus Chevrolat.	
Disk of thorax moderately densely punctured; anterior margin of clypeus not straight throughout its length, the median portion being straight and distinctly in advance of the lateral extremities; 7.5 millimeters.	
C. clypealis sp. nov.	
4. Frons distinctly bi-impressed, labro-clypeal suture straight between bases of mandibles, clypeus not horizontally impressed; 7.5 millimeters.	
C. vicinus sp. nov.	
Frons convex without trace of impressions, labro-clypeal suture somewhat as in <i>clypealis</i> , clypeus with deep horizontal impression; 9.5 millimeters.	
C. mindanensis sp. nov.	
5. Head and thorax with large, evenly and widely spaced punctures, elytra black; length 6 millimeters; habitat northern Luzon.	
C. bacillus Heller.	
Head and thorax with fine punctures; elytra brown with black tips....	6.
6. Basal two-thirds of elytra brown, tips of elytra smooth except for continuation of ninth and tenth rows of punctures as weak grooves, thorax without longitudinal groove.....	
C. bicolor sp. nov.	
Basal four-fifths of elytra brown, tips of elytra roughened by continuation of all puncture rows as grooves, thorax with longitudinal median groove.....	
C. bakeri sp. nov.	

**Cladiscus strangulatus Chevrolat.**

*Cladiscus strangulatus* CHEVROLAT, Ann. Soc. Ent. France (2) 1 (1843) 33; LACORDAIRE, Gen. Col. Atlas (1857) pl. 45, fig. 4.

Black with the exception of the thorax which is reddish. Head coarsely and rather sparsely punctured, eyes prominent, coarsely granulate, antennæ reaching to base of thorax, first segment reddish, rami long and slender. Thorax very sparsely punctured, the punctures about same size as those of head, sides more densely punctured, sides of constricted portion longitudinally strigose, at base with two low rounded tubercles above. Elytra with ten rows of very large, quadrate punctures, these punctures wider than the interspaces and absent on apical fourth which is smooth with fine sparse punctures. Suture simple, lateral margin with strong bead. Pro- and mesosterna coarsely sculptured, metasternum smooth with fine punctures. Abdomen finely punctured. Fifth sternite with shallow, broad, even emargination. Legs rough, the tibiæ slightly bent. Entire insect sparsely covered with fine hairs. Length, 9.5 millimeters.

Luzon, Benguet Subprovince, Baguio (*Baker* 11906).

Originally described from the "Philippine Islands." This is the only species before me that satisfies Chevrolat's diagnosis. The members of this genus appear to me to be rather local and it is probable that many of the references in literature to this species apply to other closely allied forms. It has been reported from the "East Indies" by Schenkling (1910) and from numerous localities by the late Rev. H. S. Gorham.

**Cladiscus clypealis sp. nov.**

Similar to last but smaller and with much denser punctuation on head and thorax. Color bluish black, head may be black or reddish, thorax reddish. Head more evenly punctured, frons feebly bi-impressed, antennæ reaching well beyond base of thorax, which is more evenly and densely punctured. Constricted portion and base of thorax as in *strangulatus* Chevr. Elytra long and parallel, sculpture as in *strangulatus* Chevr. but with the individual punctures smaller, about equal in width to the interspaces. Underparts more heavily sculptured than in the preceding species, fifth sternite and legs as in the preceding. Length, 7.5 millimeters.

Luzon, Laguna Province, Mount Maquiling: Benguet Subprovince, Baguio (*Baker*). Type from Mount Maquiling.

*Cladiscus vicinus* sp. nov.

Similar in appearance to *clypealis* sp. nov., but more coarsely sculptured throughout. Black, thorax reddish. Punctures of head coarse, not sharply defined, moderately dense. Thorax especially at anterior margin densely punctured; constricted portion of thorax with five longitudinal ridges on each side, basal margin of thorax with distinct bead. Elytra long and parallel, the punctures very large, the interspaces about half as wide as the punctures themselves; the punctures are so crowded as to make the interspaces irregular, producing the effect of reticulations. Underparts not as coarsely sculptured as in *clypealis* sp. nov. Fifth sternite nearly straight across. Tibiae straight. Length, 7.5 millimeters.

Luzon, Benguet Subprovince, Baguio (*Baker* 6076).

*Cladiscus mindanensis* sp. nov.

Bluish black, thorax reddish. Head and thorax moderately, finely, and densely punctured, antennae about as long as head and thorax together, constricted portion of thorax with indistinct ridges, apparently eight in number. Basal margin beaded. Elytral punctures large, quadrate, wider than interspaces, with distinct setigerous punctures along tops of interspaces, apices of elytra less abruptly rounded than in preceding species. Sculpture of underparts fine and dense, fifth sternite almost straight across, sixth more deeply emarginate. Legs slender, tibiae slightly bent. Length, 9.5 millimeters.

MINDANAO, Bukidnon Province, Tangkulan. BASILAN (*Baker*). Type from Tangkulan.

*Cladiscus bacillus* Heller.

*Cladiscus bacillus* HELLER, Philip. Journ. Sci. 19 (1921) 531, pl. 1, fig. 7.

Color varies from black to reddish brown on head and thorax. Head rather sparsely but deeply punctured, antennae almost reaching base of thorax. Thorax more densely punctured than in the species of the last section, punctures deep and distinct; constricted portion of thorax with nine or ten longitudinal ridges of varying lengths, basal tubercles almost fused. Elytra long, parallel, convex, their tips truncate and minutely serrate. Punctures large, interspaces narrow with setigerous punctures. Underparts rather sparsely punctured, the metathorax alutaceous. Fifth sternite broadly and shallowly emarginate, sixth entire.

Legs heavily sculptured, tibiæ rather stout and straight. Length, 6.5 millimeters.

Luzon, Benguet Subprovince, Baguio (Baker 11907).

The specimens before me differ in no wise from the original description.

*Cladiscus sanguinicollis* Spinola. Plate 1, fig. 2; Plate 3, fig. 22.

*Cladiscus sanguinicollis* SPINOLA, Monog. Clérites 1 (1844) 125.

This species was described from a mutilated specimen said to have come from Manila. I have seen no specimens that fit the description from the Philippine Islands but have a series taken at Singapore by Professor Baker. It is doubtful whether the specific name should be continued in the Philippine list. Schenkling (1910) reports the species from "Ostindien, Andamanen."

*Cladiscus bicolor* sp. nov.

Head, mouth parts, thorax, pro- and mesosterna, anterior and mesial coxæ, and basal two-thirds of elytra brown, rest of insect black. Head at sides and on vertex closely punctured, antennæ very much longer than head and thorax. Thorax finely punctured, almost rugose at sides; constricted portion longitudinally strigose, basal tubercles fused, basal margin with fine bead. Elytra long and narrow, not quite four times as long as wide, punctures large, quadrate, about equal in width to interspaces, apical portion smooth, finely punctured, apices slightly truncate. Underparts finely sculptured, fifth sternite broadly triangularly emarginate, sixth truncate. Legs heavily sculptured, tibiæ rather stout and nearly straight. Length, 8 millimeters.

MINDANAO, Dapitan (Baker).

Related to *C. parrianus* Westw., from "Inde orientale," but differs especially in the length of the antennæ, which in *C. parrianus* are not as long as head and thorax together.

*Cladiscus bakeri* sp. nov.

Somewhat of the appearance of *C. bicolor* sp. nov. but proportionately much longer. Head, mouth parts except tips of mandibles, thorax, pro- and mesosterna, anterior and mesial coxæ, and basal four-fifths of elytra brown. Head evenly and finely punctured. Clypeus with strong transverse ridge, antennæ as long as head and thorax together. Thorax slightly rugose, the individual punctures distinct only on anterior portion, with a

median longitudinal groove running from anterior constrictions nearly to base, basal tubercles separate, basal margin beaded. Elytra long and narrow, five times as long as wide, punctures quadrate, larger than width of interspaces, apical portion grooved by continuation of puncture rows. Apices evenly rounded. Underparts finely (on the thorax very densely) punctured, fifth sternite with a semicircular emargination occupying the median three-fourths of the width, sixth slightly emarginate. Legs heavily sculptured, tibiæ curved at base. Length, 11.5 millimeters.

MINDANAO, Surigao (*Baker*).

Also related to *C. parrianus* Westw.

Genus **DIPLOPHERUSA** Heller

*Diplopherausa* HELLER, Philip. Journ. Sci. 19 (1921) 530.

This genus was based upon a single individual of a new species from Mount Banahao, Luzon. As I have seen no specimens that may be referred here, I quote the original descriptions of genus and species.

Genus **DIPLOPHERUSA** novum

*Tillinorum* prope *Cladiscus*

Antennæ ab articulo tertio longe biramosæ. Labrum recte truncatum. Palpi maxillares articulo ultimo breviter subcylindrico, palpi labiales articulo ultimo perlongo, cylindrico, acuminato. Oculi transversi, reniformes. Prothorax latitudine haud longior, globosus, basi fortiter constrictus. Tibiae anticae rectae, posticae tumidae. Unguiculi in dimidia parte basali dentato-dilatati.

*Diplophorus* Fairm. has similar, but much shorter bipectinate antennæ; notwithstanding this the new genus is more closely allied to *Cladiscus*. It is distinguished from *Cladiscus* by the long bipectinate antennæ, as well as by the very long apical joint of labial palpi which is six times longer than thick; the medially subtransversely spheric thorax; the thickened hind tibiæ; and the broadly dentate unguiculi.

The above remarks concerning the relationship of the genus should be somewhat modified. For instance, *Cladiscus laniger* Schklg. from Sumatra has biramose antennæ and moderately long labial palpi; *C. laniger* Schklg. is a somewhat aberrant member of the genus, the elytra are furnished with longitudinal elevated ridges as in certain hispids. The thorax does not conform to the usual shape and sculpture, nor is the head typical. An examination of other species now unknown to me may indicate a division of the genus along the above-mentioned lines.

**Diplopherus tumidipes Heller.**

*Diplopherus tumidipes* HELLER, Philip. Journ. Sci. 19 (1921) 531, pl. 1, fig. 6.

Heller's description is as follows:

Nigro-cyanæa, antennæ atris, articulis 3 ad 10 subter longe biramosis, elytris palpisque testaceis; prothorace margine basali sanguineo, creberime punctato, margine antico leviuscculo, parte basali constricto transverse subrugoso; elytris crebre seriatopunctatis, in dimidia parte, minore, apicali, dense punctulatis; tibiæ posticis fortiter clavatis.

Long. 11 mm. lat. 2.2.

Luzon, Mount Banahao.

Body dark steel blue, thorax coarsely and densely punctate, in the apical part with fine and scattered punctures, on the contracted basal part transversely wrinkled, the basal margin dark red; elytra pale cinnamon in color, in the basal two-thirds coarsely and subtransversely seriate-punctate, on the posterior third with irregular fine and dense punctures; hind tibiæ strongly clavate.

There should be no difficulty in recognizing the species from the above description.

**Genus CYLIDROCTENUS Kraatz**

*Cylidroctenus* KRAATZ, Ann. Soc. Ent. Belg. 33 (1899) 214; SCHENKLING, Gen. Ins. (Wystsman) Cleridae (1903) 37.

*Cylidroctenus* SCHULTZE, Philip. Journ. Sci. § D 11 (1916) 45 (misprint).

Hardly to be separated from *Tillus* Olivier. Thorax broadly rounded at sides, anterior constriction deeper than in *Tillus*. Labrum feebly emarginate. Otherwise similar to *Tillus*.

Genotype, *Cylidroctenus chalybeus* (Westwood).

The only member of this genus is widely distributed over Malaya. The following description has been prepared from examples from the Philippine Islands:

***Cylidroctenus chalybeus* (Westwood).**

*Tillicera chalybeum* WESTWOOD, Proc. Zool. Soc. London (1852) 41, pl. 24, fig. 5; KRAATZ, Ann. Soc. Ent. Belg. 33 (1899) 214.

Entirely metallic blue except for postmedian spot which is reddish orange and mouth parts which are black. Head finely and sparsely punctured, eyes rather prominent, antennæ with segments 2 and 3 nearly equal, segment 4 elongate-triangular, segments 5 to 10 broadly triangular, terminal segment oval, entire organ slightly longer than head and thorax together. Thorax strongly dilated above and at sides, rather densely and

evenly punctured, pubescence at sides pale, not dense. Scutellum densely covered with silvery hairs. Elytra with ten rows of coarse punctures at base, sutural row fails before middle of length, fourth row ends at sutural end of orange spot, which is transversely oblong and reaches the lateral margin; the humeral callus is impunctate, puncture rows 7 and 8, directly back of humeral callus, are badly confused, apices of elytra back of orange spot are evenly and finely punctate. Underparts, except for lateral portions of first sternite which are smooth, evenly and rather densely punctate, moderately densely pubescent. Legs short, femora stout, tibiæ densely hairy, tarsi moderately long, claws with broad basal appendage and accessory tooth. Length, 6 to 8.5 millimeters.

Specimens from Iligan and Kolambungan, Mindanao, and Mount Limay, Luzon, have been examined. There is little variation shown other than in size. A handsome and striking species, accurately figured by Westwood.<sup>1</sup>

#### Genus *TILLUS* Olivier

*Tillus* OLIVIER, Ent. No. 22 2 (1790); SPINOLA, Monog. Clérites 1 (1844) 92; LACORDAIRE, Gen. Col. 4 (1857) 428; SCHENKLING, Gen. Ins. (Wytsman) Cleridae (1903) 12; Cat. Col. (Junk) Cleridae (1910) 11; GAHAN, Ann. & Mag. Nat. Hist. VIII 5 (1910) 62.

*Cylinder* VOLT, Cat. Syst. Col. 1 (1806) 78.

*Tilloidea* CASTELNAU, Ann. Soc. Ent. France (1) 1 (1832) 398.

A revision of the genus *Tillus* Olivier would undoubtedly result in the formation of several groups of species under separate generic names, and *Tilloidea* Castelnau would be re-established as a valid genus. The Philippine species are more nearly related to *T. unifasciatus* Oliv., the type of *Tilloidea* Cast., than to *T. elongatus* (Linn.), which is the type of *Tillus*. The following generic diagnosis refers to the Philippine species and not to *Tillus elongatus* (Linn.):

*Generic characters.*—Tillinæ; head short and round, vertical, labrum broad and entire, mandibles stout with internal tooth beyond middle, terminal segment of maxillary palp elongate-cylindrical, slightly acuminate, that of labial palp broad, somewhat triangular, eyes finely granulate, emarginate, rather prominent; antennæ eleven-segmented, first segment stout, slightly bent, second and third short, nearly equal in length, the

<sup>1</sup> Proc. Zool. Soc. London (1852) 41, pl. 24, fig. 5.

second thicker than third, fourth to sixth roughly triangular, each slightly broader than the preceding, seventh to tenth transversely quadrate, the outer margin curved, mutually equal or nearly so, eleventh longer and oval. Thorax as wide as head, sides parallel nearly to base, disk strongly convex, suddenly and strongly constricted at base, anterior coxal cavities completely closed behind. Elytra long, covering body, suture closed. Abdomen with six visible ventral segments, the first longer than any of the succeeding. Secondary sexual modifications slight. Legs moderate in length, femora stout, tibiæ straight, tarsi moderately broad and short, first segment longer than second, second to fourth subequal, broadly lobed, fifth longer. Claws curved, with basal process and accessory tooth, which is similar to and about as long as apical portion of claw.

Genotype, see discussion immediately preceding generic characters.

*Tillus* is an Old World genus, and the New World species that have been referred to it are not congeneric. Of the nearly forty species described, four are inhabitants of the Philippines. These may be differentiated by means of the following key:

*Key to Philippine species of Tillus Olivier.*

1. General color blue or blue black..... 2.  
General color black with red or brownish patches..... 3.
2. Elytra bifasciate, the first fascia near the base and not reaching either margin of elytra, the second postmedian, reaching outer margin but failing suture, somewhat angulate at middle. Length, (3.5 lines) 7.3 millimeters..... *T. bifasciellus* White.  
Elytra each with basal and apical spot and a postmedian transverse bar broken at suture, each elytron with a short carina near base, in the second interval. Length, 5.5 millimeters..... *T. carinatus* Schklg.
3. Elytra entirely black or with the basal portion reddish, with a postmedian band (broken at suture) and apices, dirty white. Length, 4 to 6 millimeters..... *T. notatus* Klug.  
Elytra black with a sutural brownish plagia of irregular extent; each elytron with a short deep groove in the second interval near the base; postmedially there is a short transverse whitish spot starting at the outer margin and not extending more than halfway to suture. Length, 6 millimeters..... *T. mindanensis* Chapin.

*Tillus bifasciellus* White.

*Tillus bifasciellus* WHITE, Cat. Cler. Brit. Mus. (1849) 49.

As I have not seen this species I quote the original description in its entirety.

*Tillus bifasciellus*, n. s.

Serrated part of antennæ with eight joints. Head, thorax, abdomen, and elytra of a deep blackish blue. Head and thorax polished, covered, especially on the sides, with longish ashy hairs. Elytra punctato-striate for rather more than half their length, with two transverse yellow bands, the first not far from the base, and not reaching either margin of the elytron; the second just beyond the middle, reaching the outer edge of elytron, but not extending to suture, somewhat angulated in the middle. The tip of each elytron closely covered with ashy silk-like hairs; sides of terminal segments of abdomen beneath with close silky hairs. Length  $3\frac{1}{2}$  lines.

Hab. Philippine Islands.

It may be noticed that this description fits specimens of *Cylindroctenus chalybeus* (Westwood) in all points except for the presence of a subbasal spot on each elytron. It is possible that the two names may refer to varieties of the same species.

*Tillus carinatulus* Schenckling.

*Tillus carinatulus* SCHENKLING, Deutsche Ent. Zeit. (1908) 364.

Bluish black, shining; elytra with postmedian transverse fascia, subbasal and apical round spots yellow. Head almost impunctate, thickly clothed with white hairs, antennæ as in *T. notatus* Klug. Thorax distinctly punctured, flanks with white pubescence. Elytra with rows of punctures extending to transverse fascia, with a short dirty yellow longitudinal carina in the second interval just before the base, at the side of which is an irregular spot of sulphur yellow; just behind the middle is a transverse bar of pale yellow which is rounded anteriorly and fails to reach the suture; subapically there is a round brighter yellow spot; the apices are pubescent with white hairs.

Described from specimens in the British Museum from Mindoro.

The species is unknown to me except from description. The basal and apical spots are absent in all other species known to me from the Islands and should afford an easily recognized character for distinguishing the species.

*Tillus notatus* Klug. Plate 1, fig. 3; Plate 3, fig. 24.

*Tillus notatus* KLUG, Clerii (1842) 276; SCHENKLING, Deutsche Ent. Zeit. (1908) 363.

*Tillus bipartitus* BLANCH., Voy. Pôle Sud 4 (1853) 59, pl. 4, fig. 13; LESNE, Bull. Soc. Ent. France (1909) 206.

*Tillus lewisi* GORHAM, Trans. Ent. Soc. London (1878) 160.

*Tillus multicolor* FAIRMAIRE, Ann. Soc. Ent. France VI 6 (1886) 43; LESNE, Bull. Soc. Ent. France (1909) 206.

*Tillus quadricolor* HELLER, Philip. Journ. Sci. 19 (1921) 534, pl. 1, fig. 9.

*Tillus semperanus* GORHAM, Cist. Ent. 2 (1876) (1875-1882) 62.

Form depressed-cylindrical, ground color variable, from all black to black with greater part of thorax and basal half of elytra reddish; elytra with a postmedian and a subapical transverse fascia of white, the space between the fasciae sometimes dirty white. Head shining, almost impunctate, antennæ black with the first two or three segments usually reddish. Thorax finely and more densely punctured, moderately densely clothed with long black and gray hair, the extreme base with a narrow band of short white hair. Basal half of elytra with ten rows of coarse punctures, apical half very finely and irregularly punctured. At the end of the rows of punctures there is a transverse bar of ivory white, slightly raised and smooth. Tips broadly whitish, extreme tips narrowly black. The black form, which is the typical *T. notatus* Klug (Baker 1976, 14663, Los Baños), is entirely black except for above-mentioned markings. A specimen from Medan, Sumatra (*Corporaal*) has the thorax entirely black and the basal third of the elytra reddish, the posterior limit of the red is oblique, reaching further posteriorly on the suture than on the margin. The same type of coloration is represented by a specimen from Los Baños (Baker 263) except that the base of the thorax is very narrowly red. A specimen from Leyte (Baker) is similar to the last except that the thorax is only one-half black, the posterior half of the same color as the base of the elytra. Finally, from Los Baños (Baker) I have a specimen which fits the description and figure of *Tillus quadricolor* Heller in all respects, in which the thorax and basal half of the elytra are as in the Leyte individual but the space between the pale fasciae is brownish white, the limits of the original markings still perceptible. There appears to be not the slightest variation in sculpture or proportional dimension which can be coördinated with the variations in color. Underparts varying from all black in the dark specimens to black with the sterna reddish in the variegated specimens. Length, 4 to 7 millimeters.

A widely distributed species, very variable in color. Many of the color forms have received names as is indicated by the

above-listed synonymy, but as there appears to be a total absence of structural variation among them it seems best to suppress the names.

*Tillus mindanensis* Chapin.

*Tillus mindanensis* CHAPIN, Proc. Biol. Soc. Wash. 32 (1919) 225.

Form and size of *T. notatus* Klug. Black, elytra with a central longitudinal brownish plagia and a transverse ivory white spot slightly postmedian on either side. Head black, shining, almost impunctate, antennæ as in *T. notatus*, the three basal segments piceous; mouth parts piceous except for the mandibles, which are black. Thorax slightly swollen at sides, feebly narrowed in front, strongly constricted behind, shining, finely and sparsely punctured, evenly pubescent with pale hair. Scutellum densely pubescent with white hair. Elytra long, slightly wider at apical fourth, striate-punctate on basal half, finely and irregularly punctured on apical half. Near the scutellum, between the first and second rows of punctures there is a deep longitudinal pit, as long as the distance between the third and fifth punctures of the first row. The elytra are black except for the central brown portion bounded as follows: At the base by the fourth row of punctures, thence toward the apex to about basal fourth where it is suddenly narrowed to the second row. At about the middle it is suddenly widened into a triangular lateral expansion, the outer angle of which coincides with the end of the ivory white transverse bar on the fifth row of punctures. The brown plagia disappears shortly behind the white spot and is resumed in the form of a subapical spot, common to the two elytra. The white spot reaches the lateral margin. The surface bears a few upright black spinelike hairs and toward the apex is rather densely covered with gray pile. Underparts black, shining, sparsely and finely punctured. Flanks of metasternum and abdomen covered with silvery hairs. Legs black except for apical half of tibiæ and the whole of the tarsi which are rufopiceous. Length, 5.5 millimeters.

MINDANAO, Davao (Baker 4268).

It may be noticed that two of the four species of *Tillus* from the Philippine Islands have some sort of modification on the elytra near the scutellum. A species from Borneo, *T. nitidicollis* Chpn., falls also into this category. A study of other species of the genus may show a similar modification, and the character may prove of value in separating certain closely allied species.

## Genus GASTROCENTRUM Gorham

*Gastrocentrum* GORHAM, Cist. Ent. 2 (1876) 63; SCHENKLING, Gen. Ins. (Wystsman) Cleridae, Fasc. 18 (1903) 22; GAHAN, Ann. & Mag. Nat. Hist. VIII 5 (1910) 61.

*Generic characters.*—*Tillinæ*; head hypognathous, labrum broadly angulately emarginate, mandibles stout, with internal tooth beyond middle, terminal segment of maxillary palp large, cylindrical, somewhat thickened at middle, that of labial palp securiform, almost as broad as long; antennæ eleven-segmented, first segment stout, longer than thick and somewhat bent, second short and globular, third longer than any of the following segments, 4 to 7 short, equal, moniliform, 8 to 10 broader than long, somewhat triangular, eleventh somewhat longer than tenth, cultriform, segments 8 to 11 opaque. Thorax longer than broad, sides somewhat gibbose, anterior coxal cavities closed behind. Elytra long, parallel, convex, covering body. Abdomen with six visible ventral segments, the first as long as the second and third together, intercoxal process of first segment conspicuous, grooved longitudinally. Secondary sexual modifications slight. Legs moderately long and stout, tarsi broad, first tarsal segment shorter than second but distinctly visible from above, second to fourth subequal, fifth longer. Claws long and curved, basal process small, inconspicuous, accessory tooth similar to and almost as large as apical portion of claw.

Genotype, (*Gastrocentrum pauper* Gorh. 1876) = *Gastrocentrum unicolor* (White) 1849.

The genus is represented in the Philippines by its type species.

*Gastrocentrum unicolor* (White). Plate 1, fig. 4.

*Tillus unicolor* WHITE, Cat. Cler. Brit. Mus. (1849) 56.

*Gastrocentrum pauper* GORHAM, Cist. Ent. 2 (1876) (1875-1882) 63.

Dark castaneous. Head with epistoma broadly emarginate, eyes large, prominent, distinctly margined, head finely and densely punctured, sparsely covered with short fine golden pubescence. Thorax with sides sinuate, variable within the species, longer than broad, constricted basally, basal margin fine and distinct, surface very finely and densely punctured. Visible portion of scutellum transversely oval. Elytra long, parallel, convex above, tips together rounded, suture finely margined, punctures nearly circular, arranged in about fifteen rows, in some specimens many of the punctures are entirely absent, punctures disappear on declivity; surface between punctures minutely punctulate; elytra densely and evenly covered with fine short golden pubescence. Underparts finely punctured,

densely pubescent. Legs rugose, bases of femora and apices of tibiae paler in color. Length, 9 to 16 millimeters.

MINDANAO, Davao and Dapitan (Baker 7285, 13516).

#### HYDNOCEPINÆ

*Subfamily characters.*—Cleridæ; head with eyes, which are very large and hemispherical, wider than thorax; antennæ eleven-segmented with a two- to five-segmented club; terminal segment of maxillary palpi cylindro-acuminate, that of labial palpi large, elongate-triangular. Thorax laterally dilated before the middle, anterior coxal cavities very widely open behind. Elytra completely covering the abdomen or abbreviated, elytral punctures variable. Terminal segments of abdomen, especially in the male, with sexual modifications. Legs long and slender.

There are three genera in the Philippine fauna that may be referred to this subfamily, one of which has up to this time been placed in the Tillinæ, and one characterized here for the first time. The reasons for the change in position of this genus have been reviewed in the introductory part of this paper. The following key serves to point out the conspicuous differences among the three:

*Key to the Philippine genera of the subfamily Hydnocerinæ.*

1. First tarsal segment small, covered by the second; size small, less than 5 millimeters..... *Neohydinus* Gorham.
- First tarsal segment long, not covered by the second; size larger, over 5 millimeters..... 2.
2. Form elongate, slender, parallel; elytra with pattern of scales; antennal club of three segments..... *Callimerus* Gorham.
- Form broad and compact; elytra never with scales; antennal club of five segments..... *Brachycallimerus* g. nov.

#### Genus NEOHYDNUST Gorham

*Neohydinus* GORHAM, Ann. Mus. Stor. Nat. Genova 32 (1892) 742;  
SCHENKLING, Gen. Ins. (Wytsman) Cleridae, Fasc. 18 (1903) 94;  
Col. Cat. (Junk) Cleridae, Paris 23 (1910) 107.

*Generic characters.*—Hydnocerinæ with the first tarsal segment short. Head vertical; labrum entire; mandibles stout, falcate, with short internal tooth toward apex; terminal segment of maxillary palpi cylindro-acuminate, that of labial palpi dilated, elongate-triangular; antennæ short, capitate, apparently ten-segmented (the tenth and eleventh segments being ankylosed), first segment short and thick, slightly bent, second nearly spherical, third to ninth trapezoidal, becoming successively shorter to eighth or ninth, ninth sometimes longer than

eighth, tenth and eleventh together oval and flattened; eyes large and convex, finely granulated, minutely emarginate at base of antennæ. Thorax with length and breadth subequal, slightly dilated at sides, lateral foveæ above dilations 2 or 3, usually distinct, anterior coxal cavities widely open behind. Elytra usually as long as body, suture slightly dehiscent toward apices, lateral margin and tips usually strongly serrate, punctuation irregular, never in longitudinal rows. Abdomen with six visible ventral segments. Sexual modifications of males usually conspicuous. Legs slender, femora somewhat swollen; tarsi short, of five segments, first segment short and ventral to second, claws with a broad basal process.

Genotype, *Neohydnus despectus* Gorham. Monobasic.

Geographic range, Indo-Malaysia.

There appears to be very little other than habitat to separate these forms from the American genus *Hydnocera* Newman and a better knowledge of the entire Indo-Malayan fauna may show the necessity of uniting the two genera under the latter name. On the other hand, continued study of a group often discloses certain characters, previously overlooked or considered of little importance, that serve to sustain what appeared to be bad judgment of a previous author.

One species of this genus, *Neohydnus pallipes* Kr. (Plate 1, fig. 5; Plate 3, fig. 26), has been reported from the Philippine Islands. While it may be found at some future time in Mindanao or Basilan, it seems to me very unlikely. The type locality for the species is Sumatra, and I have seen specimens from Singapore and Borneo. The Bornean individual, however, is not typical and might easily be considered specifically distinct. Considering the amount of variation seen here, together with the lack of variation along the same lines displayed in a series from Sumatra, I am inclined to believe that the nearest Philippine relative of the species would have to be considered as another species. Disregarding the above species, there are now thirteen species of the genus before me from the Islands which may be distinguished inter se by means of the following key:

*Key to Philippine species of Neohydnus Gorham.*

1. Pubescence of elytra not in patches but evenly distributed over the entire surface ..... 2.
- Pubescence of elytra in patches, distinctly visible when the insect is held in certain positions ..... 9.
2. Elytra unicolorous ..... 3.
- Elytra maculate or striped ..... 7.

3. Form depressed, elytra at apical fourth wider than at base, head and thorax nearly equal in width and narrower than base of elytra, tips of elytra apparently entire..... *N. attalus* sp. nov.

Form somewhat convex, parallel, tips of elytra strongly serrate..... 4.

4. Surface of elytra between punctures smooth and shining..... 5.

Surface of elytra between punctures finely granulate or alutaceous, opaque ..... 6.

5. Punctuation of elytra very coarse, punctures of thorax very coarse and sparse ..... *N. bakeri* var.

Punctuation of elytra moderately fine and dense, thorax with very fine punctures, almost impunctate..... *N. luzonicus* sp. nov.

6. Terminal dorsal abdominal segment of male evenly rounded, last complete ventral with three triangular projections.

*N. granulatus* sp. nov.

Terminal dorsal with median lobe, last complete ventral not produced.

*N. auripilosus* sp. nov.

7. Elytra striped, the pale stripe commencing at base and continuing indefinitely toward apex, dark portions iridescent... *N. pictus* sp. nov.

Elytra maculate but never pale at base..... 8.

8. Each elytron with a pale spot at apical third..... *N. colon* sp. nov.

A large, transversely oval pale spot at basal third common to both elytra, apices sometimes pale..... *N. bakeri* sp. nov.

9. Disk of thorax smooth, shining, almost impunctate..... 10.

Disk of thorax wrinkled or alutaceous..... 11.

10. Each elytron with basal, median, and apical spots of golden pubescence; surface of elytra between punctures alutaceous.

*N. sexnotatus* sp. nov.

Each elytron with postmedian and apical spots of pubescence; surface shining, punctures shallow and well separated..... *N. tibialis* sp. nov.

11. Pubescence of scutellum, median transverse arcuate fascia, and subapical fascia of silvery pubescence..... *N. scutellatus* sp. nov.

Scutellum not conspicuously pubescent..... 12.

12. Pubescence aureous, extending entire length of suture, with lateral outgrowths near base, postmedianly and at apex, outer margin near apex pubescent; punctures of elytra coarse and rather sparse.

*N. pilosus* sp. nov.

Pubescence argenteous, restricted to three spots on each elytron; punctures coarse and crowded..... 13.

13. Anterior thoracic impression composed of a series of pits, beadlike; elytra with lateral margins parallel..... *N. constrictus* sp. nov.

Anterior thoracic impression not composed of pits but of parallel grooves; elytra wider at apical fourth than at base.

*N. ater* sp. nov.

***Neohydinus attalus* sp. nov.**

Form depressed, head and thorax narrow, elytra widest toward apices. Color black except for antennæ, mouth parts, and portions of legs, which are testaceous. Head (including eyes) with nearly circular outline, very finely punctured, and sparsely set with silvery hairs; antennæ rather short, with the sixth and eighth segments smaller than the fifth, seventh, or ninth.

Thorax slightly wider than long (30–32), anterior and basal transverse impressions deep and distinct, surface very uneven but without distinct punctures and with a short median longitudinal carina extending from anterior groove one-third distance toward basal, sides somewhat dilated and with two unequal foveæ, the anterior one the larger. Elytra at widest part half again as wide as at humeri, coarsely and closely punctured, suture strongly beaded, lateral margin and tips, which are subtruncate, feebly serrate; surface of elytra and thorax sparsely set with whitish hairs. Underparts shining black, very finely and sparsely punctured. Legs black except for inner portions of anterior femora and tibiæ, all tarsi and trochanters, and tips of hind tibiæ which are whitish. Length, 3.5 millimeters.

Type, a specimen, sex uncertain, from Mount Maquiling, Laguna Province, Luzon (*Baker*).

**Neohydinus ater** sp. nov.

Form somewhat as in *attalus* but more elongate. Color black, appendages slightly paler. Head very finely punctured, sparsely clothed with silvery pubescence; antennæ short, segments distinctly punctured, club oval. Thorax equilateral, surface finely pebbled, anterior transverse impression broad and shallow, composed of several parallel grooves, basal impression distinct, lateral dilation feeble, lateral foveæ triple, almost confluent. Elytra broader toward apices than at base, coarsely and closely punctured, each with a small irregular spot of silvery hairs near basal fourth, a second, somewhat larger, postmedian, and a patch of sparsely placed hairs at apex, suture, and lateral margins strongly beaded, lateral margin and apices serrate. Underparts finely punctured, not conspicuously pubescent. Length, 3.5 millimeters.

Type, a specimen, female?, from Baguio, Benguet Subprovince, Luzon (*Baker*).

Easily separated from *N. attalus* by the structure of the thorax and by the presence of patches of scales on the elytra.

**Neohydinus bakeri** sp. nov.

Form parallel, rather convex above. Head and thorax black, elytra bluish black with a transverse oblong testaceous spot common to both at basal fourth (sometimes reduced or absent), underparts black, antennæ, mouth parts, and legs rufotestaceous. Head almost impunctate, clypeus and frons densely covered with short silvery pubescence; antennæ short, club tri-

angular, abruptly truncate at tip. Thorax broader than long (30–37), anterior transverse impression conspicuous, distant from anterior margin, posterior impression deep and well defined, lateral dilation moderate; lateral foveæ triple, most posterior one shallow, surface finely wrinkled, almost alutaceous. Elytra long, suture closed, lateral margins and tips rather coarsely serrate, punctures coarse, densely and evenly distributed. Pubescence sparse, evenly distributed. Apices separately rounded. Underparts finely, almost imperceptibly punctured. Legs moderately long, tarsi rather short. Length, 3.5 millimeters.

*Male*.—Fifth ventral with a long sharp median denticle, which is almost as long as the average length of the segment.

*Female*.—Ventral segments unmodified.

Type, a male from Basilan (*Baker 11881*); paratypes, specimens of both sexes from Basilan (*Baker 11880, 11882*) and from Surigao, Mindanao (*Baker*).

The single spot on the elytra varies considerably in size, and in two specimens is entirely absent.

#### *Neohydinus luzonicus* sp. nov.

Form elongate, parallel, depressed. Color greenish black except for the antennæ, mouth parts, and legs, which are testaceous. Head finely and sparsely punctured, moderately densely clothed with short pale golden pubescence; antennæ with eighth segment smaller than seventh or ninth. Thorax broader than long (26–31), slightly swollen at sides, anterior and basal transverse impressions distinct, lateral foveæ triple, the most posterior one poorly defined, median line broad and impunctate, other portions rough with a few fine punctures. Elytra closely and coarsely punctured, the punctures not sharply delineated; suture strongly beaded and closed almost to apex, lateral margins and apices serrate; apices separately rounded; surface evenly and not densely covered with pale pubescence. Underparts finely and more densely punctured, legs pale, tips of tarsi darker. Length, 3 to 4.5 millimeters.

*Male*.—Fifth ventral segment feebly emarginate, slightly protuberant at middle, last dorsal truncate.

*Female*.—Ventral segments unmodified, simple.

Type, a male from Mount Maquiling, Laguna Province, Luzon (*Baker 2406*); paratypes, specimens from Los Baños, Laguna Province, Luzon (*Baker 8289*) and from Baguio, Benguet Sub-province, Luzon (*Baker 6075*).

**Neohydrus granulatus sp. nov.**

Form elongate, parallel. Color black, elytra with slight bluish reflections, antennæ, mouth parts, and tarsi piceous, legs rufo-testaceous. Head almost impunctate, sparsely covered with a mixture of golden and silvery pubescence; club of antennæ oval. Thorax wider than long (36–43), anterior transverse impression much confused on disk, consisting at that point of at least five distinct parallel grooves, basal impression deep, distinct, single; surface, especially between anterior margin and anterior impression, wrinkled, disk smoother with a few scattered setiferous punctures; lateral dilation moderate, lateral foveæ triple as in *N. bakeri*. Elytra long and narrow, suture closed almost to tip, surface rather finely and closely punctured, punctures shallow and not well defined, surface between punctures alutaceous; lateral margins and tips rather coarsely serrate, tips separately rounded. Pubescence fine, sparse, erect, pale. Underparts finely and sparsely punctured, legs long and slender. Length, 4.5 millimeters.

*Male*.—Fifth ventral tridentate, the teeth triangular and so arranged as to divide the width of the segment into fourths.

*Female*.—Unknown.

Type, a male from Dapitan, Zamboanga Province, Mindanao (Baker).

**Neohydrus pictus sp. nov.**

Form parallel, rather abruptly narrowed behind, convex above. \*Head and thorax greenish black, suture and lateral margins of elytra metallic green, iridescent, discal portion of elytra, antennæ, mouth parts and legs testaceous, underparts black. Head shining, no punctures visible under moderate powers; antennæ short, about as long as longest diameter of eye. Thorax slightly broader than long (30–35), anterior transverse impression shallow, basal deeper, surface finely alutaceous, lateral impressions triple, round and deep; on the median line just above the basal impression there is a circular tubercle. Scutellum small and triangular. Elytra entirely covering the abdomen, tips separately rounded, lateral margins and tips strongly serrate, surface coarsely and densely punctured, punctures near suture sparser and somewhat confused. Legs testaceous, femora toward tips and tibiæ near bases ringed with dark. Length, 3.5 millimeters.

*Male*.—Unknown.

*Female*.—Ventral segments apparently unmodified.

Type, a female from Kolambungan, Lanao Province, Mindanao (Baker).

**Neohydrus tibialis sp. nov.**

Black, slightly aeneous, each elytron with a circular patch of pale pubescence medianly and a smaller elongate patch of similar pubescence toward apex. Form parallel, somewhat depressed. Head very finely and sparsely punctured, with a few scattered pale hairs; antennæ about as long as greatest diameter of eye, with the fourth, sixth, and eighth segments larger than the fifth or seventh, the tenth and eleventh together broadly oval. Thorax broader than long (22–27), surface smooth except for a few scattered punctures, lateral dilations moderate, lateral foveæ double, deep and distinct, anterior transverse impression feeble, basal a well-defined groove. Scutellum small and inconspicuous. Elytra long, suture closed nearly to apex, lateral margins strongly serrate, tips separately rounded with a few teeth, surface moderately densely and coarsely punctured, pubescence as described above. Sides of mesosternum with a few very large punctures, metasternum very finely punctured and sparsely pubescent. Legs moderately thin and long, tibiae and tarsi, together with the extreme tips of the femora, brown. Length, 3.6 millimeters.

*Male*.—Unknown.

*Female*.—Ventral segments apparently unmodified.

Type, a female from Baguio, Benguet Subprovince, Luzon (Baker).

**Neohydrus constrictus sp. nov.**

Black, each elytron at apical two-fifths with a central circular spot and an irregularly shaped spot near the lateral margin, of pale pubescence; apices also pubescent. Form elongate, head and thorax conspicuously narrow. Head sparsely punctured, surface rather closely covered with pale depressed pubescence, front rather narrow; antennæ short, stout, the segments from sixth on wider than usual, almost as wide as tenth and eleventh. Thorax as long as broad, though appearing at first glance to be elongate; surface rugose, disk with a short median longitudinal carina which crosses the anterior transverse impression, basal impression deep and distinct, lateral dilations feeble, lateral foveæ triple and distinct. Elytra very gradually and slightly widened behind, suture closed nearly to apex, lateral margins

and tips, which are rounded, serrate; surface coarsely and densely punctured, almost reticulate. Underparts black, mesosternum coarsely, metasternum finely punctured. Legs mostly pale, apical half of hind femora and basal half of hind tibiæ dark, all tarsi pale. Length, 3.7 millimeters.

*Male*.—Last dorsal and last visible ventral evenly rounded.

*Female*.—Unknown.

Type, a male from Mount Maquiling, Laguna Province, Luzon (Baker 6074).

**Neohydnus auripilosus sp. nov.**

Form elongate, subparallel. Color black, antennæ, mouth parts, and legs paler; elytra rather densely clothed with golden pile. Head very finely and rather densely punctured, thickly clothed with silvery depressed hairs; antennæ short, club oval, piceous. Thorax slightly broader than long (32–35), anterior transverse impression moderately distinct, lateral dilation moderate, lateral foveæ triple, basal impression deep and distinct, surface finely wrinkled, more especially so anteriorly, with fine punctures; pubescence sparse. Elytra long and narrow, densely and coarsely punctured, punctures disappearing toward apices, surface between punctures alutaceous, suture dehiscent toward tips, lateral margin and apices coarsely serrate. Underparts black and shining, finely punctured, legs uniformly pale. Length, 4 to 4.5 millimeters.

*Male*.—Last dorsal segment with truncated median lobe, last ventral broadly and not deeply emarginate.

*Female*.—Last ventral with a broad and shallow median longitudinal groove.

Type, a male from Basilan (Baker); paratype, a female from the same locality (Baker).

**Neohydnus colon sp. nov.**

Form elongate, parallel, width across apical third of elytra slightly less than at base or apex. Color black, except for antennæ, mouth parts, most of legs, and elytral spots, which are pale testaceous. Head finely alutaceous, punctures indistinct, frons with depressed silvery pubescence; antennæ short and stout, club oval. Thorax wider than long (28–31), surface shining but distinctly uneven; individual punctures very fine, almost obsolete; anterior transverse impression composed of a series of quadrate punctures instead of the usual continuous

groove; lateral dilations broad but not very prominent; greatest width at anterior third; lateral foveæ double, the usual posterior (third) fovea absent; basal transverse impression normal. Elytra dehiscent from apical third, lateral margins and apices coarsely serrate, punctures very coarse and closely placed, apices slightly tumid, pubescence pale, sparse, and erect. Each elytron with a single transversely oval pale spot at apical third. Underparts shining, very finely and sparsely punctured. Legs pale, the basal extremity of the posterior tibia infuscate. Length, 3 millimeters.

*Male*.—Terminal dorsal abdominal segment evenly rounded, last visible ventral slightly truncate.

*Female*.—Unknown.

Type, a male from Basilan (*Baker*).

**Neohydrus sexnotatus sp. nov.**

A large, compactly built, oblong species. Color black, antennæ, mouth parts, and legs piceous; each elytron with three large patches of golden pubescence. Head smooth and shining, very finely and sparsely punctured, sparsely pubescent; antennæ moderate in length, club oval. Thorax short and broad (40–52), anterior and basal transverse impressions deep and distinct, lateral foveæ triple, surface except on disk coarsely wrinkled, disk smooth and polished with few punctures; pubescence sparse and erect. Elytra long and parallel, suture closed almost to tips, lateral margins and apices coarsely serrate, surface coarsely and densely punctured, alutaceous between punctures; each elytron with patches of golden pubescence as follows: The first patch is basal and is somewhat rectangular; the second, median and transversely oval; the third, apical, elongate-oval, its major axis lying with the longitudinal axis of the elytron. Underparts shining, finely and sparsely punctured. Legs piceous, the posterior femora in part darker. Length, 5 millimeters.

*Male*.—Unknown.

*Female*.—Terminal segments of abdomen simple, not modified.

Type, a female from Dapitan, Zamboanga Province, Mindanao (*Baker*).

**Neohydrus scutellatus sp. nov.**

Form elongate-oblong, parallel. Color black except for antennæ, mouth parts, apices of tibiæ and tarsi, which are pale; scutellum, median and subapical bars on elytra densely covered with silvery hairs. Head shining, almost impunctate, pubes-

cence sparse; antennæ rather short, club oval. Thorax broader than long (22–33), surface coarsely wrinkled, anterior and basal impressions distinct, lateral foveæ double, almost coalescing, lateral dilations rather prominent. Scutellum large and triangular, densely clothed with silvery pubescence. Elytra parallel, lateral margins and apices very feebly serrate, coarsely and not confluent punctured, surface between punctures finely alutaceous; at the middle of the length there is a transverse, curved bar of silvery hairs with the convexity directed anteriorly, and a similar bar with the convexity directed posteriorly is placed just before the apex. Underparts and legs (except for the extreme tips of tibiæ and tarsi) black. Length, 3 millimeters.

*Male*.—Unknown.

*Female*.—Terminal segments of abdomen unmodified.

Type, a freshly emerged female, somewhat distorted, from Basilan (*Baker*).

*Neohydnus pilosus* sp. nov.

Form oblong, parallel. Color black, antennæ, mouth parts, and legs pale. Head almost impunctate, sparsely covered with fine depressed aureous pubescence; antennæ moderate in length, club obconical, rounded at extremity. Thorax almost equilateral (21–22), lateral dilations weak; anterior transverse impression shallow, poorly defined, basal impression well defined, angulate at middle; lateral foveæ double, well defined, surface finely and closely punctured, well covered with depressed aureous pubescence and with a few upright pale hairs. Elytra coarsely and rather closely punctured, suture strongly beaded and closed almost to apex, evenly and sparsely set with upright pale hairs and with depressed aureous pubescence in patches, as follows: Subbasally there is a roundish patch of indefinite extent; slightly postmedian there is a V-shaped patch, the upper extremities of the V touching, respectively, the lateral and sutural margins and with the sutural half of the design much more heavily developed than the other; behind the V there is a very slight break and the pubescence is resumed and extends to the apex; in the apical fourth the pubescence is confined to the margins, leaving an irregular central spot bare; the lateral margins and apices of the elytra are serrate. Underparts black, legs (with the exception of the basal half of hind tibiæ, which is infuscate) pale. Length, 3 to 4 millimeters.

*Male*.—Unknown.

*Female*.—Terminal abdominal segments unmodified.

Type, a female from Mount Limay, Bataan Province, Luzon (Baker); paratypes, two females from the same locality.

Genus **BRACHYCALLIMERUS** novum

*Callimerus* (pars) of authors.

*Generic characters.*—Hydrocerinæ, with the first tarsal segment longer than the second. Head broad; eyes very prominent, very slightly emarginate near antennal socket; labrum entire, mandibles broad and flat, falcate, with sharp tooth internally near apex; antennæ short and compact, eleven-segmented, first segment short and stout, second nearly spherical, third to sixth longer than broad, seventh to eleventh broader than long, each wider than the preceding, together forming a compact obtangular five-segmented club. Thorax broader than long, polished, with a few distinct punctures. Elytra broader at base than thorax, punctures not in rows, numerous. Upper surface of entire insect devoid of scales. Abdomen with six visible ventral segments, secondary sexual modifications of male conspicuous. Legs moderate in length, posterior tibiæ with subapical notch, tarsi short, tarsal claws broadly toothed at base.

Genotype, *Callimerus latifrons* Gorh., 1876.

Geographical range, Indo-Malaysia.

The insects which I include in this new genus have heretofore been classified with the species of *Callimerus* Gorh. They differ from those species in their broad and compact form, short and compact antennæ, and the total absence of scales from the upper surface. In addition to the genotype, I would include the following species: *latesignatus* Gorh., *rusticus* Gorh., *pectoralis* Schklg., and probably *trifasciatus* Schklg.

*Brachycallimerus latifrons* (Gorham). Plate 1, fig. 8; Plate 3, fig. 28; Plate 4, fig. 46.

*Callimerus latifrons* GORHAM, Cist. Ent. 2 (1876) (1875-1882) 67.

*Callimerus flavofasciatus* SCHENKLING, Bull. Mus. Hist. Nat. Paris 8 (1902) 319.

Form short and broad, somewhat depressed. Color black, elytra with yellow markings, legs entirely yellow. Head finely and closely punctured, frons thickly clothed with short white hairs; antennæ with the first, second, and eighth to eleventh segments pale, the rest piceous. Thorax broader than long, (33-36), punctures sparse on disk, slightly denser at sides; anterior and basal transverse impressions well defined; lateral

dilations almost hemispherical; lateral foveæ single, almost obsolete. Elytra with punctures coarse and well separated, without definite arrangement, suture beaded, apices internally truncate, tips each with small mucro; color black with basal fourth, a transverse postmedian band, and an apical spot flavous. Underparts of thorax black except for the median portion of the mesothorax, which is pale. Abdomen piceous. Legs rather stout, pale; hind tibiæ with subapical notch. Length, 9 millimeters.

*Male*.—Fifth abdominal sternite with broad, shallow, and evenly curved emargination; sixth similar but with the emargination proportionally deeper. Terminal dorsal evenly rounded.

*Female*.—Unknown.

MINDANAO, Davao Province, Davao: Zamboanga Province, Dapitan. BASILAN (*Baker 4271*). SUMATRA, Medan (*Corporaal*). Siam.

The type locality of Gorham's name is "E. Mindanao." Schenckling described *flavofasciatus* from Siam and stated in the original description that the species differs from *latifrons* Gorh. in having a subapical spot. This spot is mentioned in Gorham's original description and all specimens before me have it. For this reason I have considered the two species synonymous.

#### Genus CALLIMERUS Gorham

*Callimerus* GORHAM, Cist. Ent. 2 (1876) (1875-1882) 65; SCHENKLING, Gen. Ins. (Wytsman) Cleridae, Fasc. 13 (1903) 24; GAHAN, Ann. & Mag. Nat. Hist. VIII 5 (1910) 61.  
*Caloclerus* KUWERTZ, Ann. Soc. Ent. Belg. 37 (1893) 480; SCHENKLING, Ann. Soc. Ent. Belg. 45 (1901) 105.

*Generic characters*.—Hydnocerinae, with the first tarsal segment longer than the second. Head vertical; labrum entire; mandibles stout, falcate, with internal tooth near apex; terminal segment of maxillary palp twice as long as preceding segment, subulate; that of labial palp elongate-triangular; antennæ moderately long, slender, distinctly eleven-segmented, first segment stout, bent, at least twice the length of the second, which is from nearly as long as broad to equilateral and globular, third to eighth much longer than broad, each segment shorter than the preceding, ninth to eleventh forming a lax, oval club, eleventh oval at tip; eyes finely granulate, prominent, very slightly

emarginate at base of antennæ. Thorax longer than broad, somewhat constricted before and behind, moderately to strongly dilated at or before the middle, anterior coxal cavities very widely open behind. Elytra entirely covering the abdomen, long, narrow, sides parallel, adorned with white or yellow scales, these scales often forming a definite pattern. Abdomen with six visible ventral segments; in the male the terminal segments are often profoundly modified; in the female the modification, if any, occurs on the penultimate segment. Legs rather long, posterior tibiae with or without a notch with comb of hairs near its apex; tarsi moderately long, five-segmented, the basal segment the longest, claws almost simple or with broad basal platelike tooth.

Genotype, *Clerus (Xylobius) dulcis* Westw., by original designation of Gorham.

Geographic range, Indo-Malaysia.

The type species, *Callimerus dulcis* (Westw.), has been reported from the Philippine Islands but is probably not found there under normal conditions. Material from Assam fits the original description and figure perfectly and, in view of the very local distribution of the other species of the genus, this is probably very near to the type locality. The locality "Java" as given in the original paper is probably a result of the lax system of labeling material in vogue eighty years ago. However, for convenience, the species is included in the key, though not treated further. There are now seventeen species known to inhabit the islands of the Philippine group, which may be distinguished by means of the following key:

*Key to Philippine species of Callimerus Gorham.*

1. Hind tibiae with subapical notch. (Section A.)..... 2.  
Hind tibia without subapical notch. (Section B.)..... 9.
2. Upper surface dark blue or black, with markings of white scales; tarsal claws with prominent basal tooth..... 3.  
Upper surface not entirely dark blue or black; thorax always testaceous or grass green; tarsal claws nearly simple..... 5.
3. Each elytron with three denuded areas along the outer margin and with an elongate lozenge-shaped spot at the middle on the suture; thorax with median and lateral denuded areas..... *C. princeps* Chapin.  
Each elytron with a number of roundish spots of white scales..... 4.
4. Each elytron with four spots..... *C. octopunctatus* Heller.  
Each elytron with seven spots..... *C. dulcis* (Westwood).
5. Puncture rows 4, 5, and 6 (from suture) not conspicuously crowded; elytra evenly covered with scales..... 6.

Puncture rows 4, 5, and 6 close together, the included surface devoid of scales, producing a striped appearance..... 7.

6. Parapenes greatly swollen behind the terminal hooks; lateral lobes of terminal abdominal tergite (male) twice as long as width at apex.  
*C. luzonicus* Chapin.  
 Parapenes not swollen behind the terminal hooks; lateral lobes three times as long as width at apex..... *C. bakeri* Chapin.

7. Scales on elytra clear white; terminal tergite of male with median process small, not more than one-fifth as long as lateral rami; lateral rami rounded at tips..... *C. basilanicus* Chapin.  
 Scales on elytra yellow..... 8.

8. Median process of terminal tergite of male short, about half as long as lateral rami; lateral rami subacute at tips; elytra without denuded stripe..... *C. intermedius* sp. nov.  
 Median process of terminal tergite of male long, nearly as long as lateral rami; lateral rami rounded at tips; elytra with denuded stripe..... *C. lateralis* Chapin.

9. Elytra blue or blue-black, with linear markings of white scales..... 10.  
 Elytra not with linear markings of white scales, if so, then not blue or blue-black ..... 11.

10. Denuded areas of elytra as follows: Two at base, followed by two incompletely inclosed large lateral areas, the suture being very narrowly bare; lateral areas connected across suture at apical part.  
*C. gratiosus* Gorham.  
 Denuded areas of elytra, two at base, followed by three more or less completely inclosed equal rectangular areas, the median rectangle common to both elytra..... *C. fenestratus* Chapin.

11. Elytra dark blue or black, almost entirely covered with white scales.. 12.  
 Elytra brown or testaceous, scales sometimes forming definite lines.. 15.

12. Species small (5.5 millimeters); vestiture of scales very dense, insect appearing snow-white except for four small round spots, a pair at middle and a pair beyond apical fourth; legs pale yellow.  
*C. albus* Chapin.  
 Species large (8 millimeters); vestiture of scales not very dense, insect appearing gray, three or more spots on each elytron, these not well defined ..... 13.

13. Each elytron with eight spots as follows: One humeral; a pair at basal fourth; a fourth small, median; a pair larger, slightly postmedian; a single one at apical fifth similar in size to last; and a small subapical spot..... *C. biscootonotatus* sp. nov.  
 Each elytron with three spots, one basal, one median, and one subapical ..... 14.

14. Male with sixth abdominal sternite emarginate at apex, the emargination broad and shallow, evenly curved..... *C. persimilis* Chapin.  
 Male with the sixth sternite bilobed, the emargination between the lobes V-shaped ..... *C. albescens* Chapin.

15. Denuded areas on elytra reduced to isolated spots or absent..... 16.  
 Elytral pattern composed of scaled areas, each separated from its neighbors by denuded lines forming an incomplete network, suture nude ..... 17.

16. Thorax and elytra entirely covered with scales; however, some portions of elytra are more densely scaled than others, producing the effect of a yellow pattern on a yellowish brown background.

*C. flavus* Chapin.  
Denuded areas poorly defined but distinctly present; thorax with three discal denuded areas..... *C. pulchellus* Gorham.

17. Scales on each elytron clearly separated into three distinct patches, one on basal half, one on apical half, and one small semicircular spot at middle near suture, which forms with the corresponding spot on the other elytron a nearly circular spot..... *C. schultzei* Schenkling.  
Scales on each elytron not divided into completely isolated patches, subsutural line of scales being unbroken throughout its length, scales on posterior half forming the conventional "trefoil" pattern.

*C. trifoliatus* sp. nov.

*Callimerus princeps* Chapin. Plate 4, fig. 29; Plate 5, fig. 50.

*Callimerus princeps* CHAPIN, Proc. Biol. Soc. Wash. 32 (1919) 227.

Elongate, parallel; black, legs, antennæ, and mouth parts pale, more or less covered with glossy white scales. Head finely and very minutely punctured, entirely covered with scales except for the vertex and a narrow line running down onto the frons. Thorax longer than wide, dilated at the middle, broadly and shallowly impressed at the apex, narrowly and more deeply at the base; a triangular median spot, and the lateral portions are free from scales. Elytra parallel, black, deeply and coarsely punctured except along the suture at the median third of the length; surface of elytra between the punctures dull alutaceous; there are seven denuded areas, one subbasal on each elytron, one median lateral on each elytron and one median central common to the two elytra, and one subapical on each; the apices of the elytra are internally obliquely truncate, the outer angle only mucronate. Underparts black, laterally densely covered with white scales. Legs pale testaceous, the femora showing traces of green pigment; posterior tibiæ with subapical notch. The entire surface of the beetle has, in addition to the scales, a vestiture of long, erect hairs, rather sparsely placed. Length, 7 millimeters.

*Male*.—Terminal abdominal tergite dilated and bifurcate. Each ramus extends outward and downward, becoming gradually widened to the tip, which is sharply truncate. The tips of the rami are turned under toward the median line. Between the rami there is a small triangular projection.

*Female*.—Fifth sternite with a lobe on either side of the median line, each lobe as long as broad and truncate. The truncature carries a row of about eight bristles. Sixth ventral simple and unmodified.

Type, a male from Basilan (*Baker 11534*). Other specimens from Basilan (*Baker 11878*), and a female from Iligan, Lanao Province, Mindanao (*Baker*).

*Callimerus octopunctatus* Heller. Plate 4, fig. 41.

*Callimerus octopunctatus* HELLER, Philip. Journ. Sci. 19 (1921) 532, pl. 1, fig. 5.

Form elongate, parallel. Color deep bluish black, antennæ and legs yellowish; each elytron with four spots. Head shining, finely and sparsely punctured, sparsely pubescent; antennæ rather short, as long as the longest diameter of eye. Thorax longer than wide, coarsely and sparsely punctured, with four spots of white scales, one spot at each corner of the disk, surface shining between punctures. Elytra long, parallel, tips obliquely truncate; angles not distinctly mucronate, surface coarsely and irregularly punctured, not shining between punctures; each elytron with four irregularly shaped spots of white scales, one basal, a second at basal fourth, a third just behind middle, and a fourth near the apex. Underparts shining, finely punctured, lateral portions densely clothed with white scales. Legs pale yellow-brown, posterior tibiæ with subapical notch. Length, 8 to 10.5 millimeters.

*Male*.—Unknown.

*Female*.—Terminal abdominal segments simple, unmodified.

Type from Mount Maquiling, Laguna Province, Luzon.

This species was described by Heller from material received from Baker. Heller compares the species with *C. pictus* Gorham. It appears to me to be more nearly related to *C. decoratus* Gorham. Through the kindness of Dr. Karl Jordan, of the Tring Museum, I have received a specimen of *C. decoratus* from Momeit, Burma, altitude 2,000 feet. The arrangement of the spots is different in the two species, the basal spots of *C. decoratus* being placed at a considerable distance from the base. The tibiæ of *C. decoratus* are darker, especially the posterior pair.

Professor Baker has sent to me this or a very close relative from Surigao and Dapitan, Mindanao (*Baker 12737*). Lacking material from Luzon I am unable to state definitely that they are the same.

*Callimerus luzonicus* Chapin. Plate 5, fig. 48.

*Callimerus luzonicus* CHAPIN, Proc. Biol. Soc. Wash. 32 (1919) 230.

Elongate; head and thorax dark testaceous, the latter usually distinctly greenish, elytra varying from piceous to rufotesta-

ceous. Head shining, almost impunctate, with a few white scales near the eyes. Thorax not strongly dilated but with distinct anterior and basal transverse impressions; lateral foveæ distinct, circular; entire surface devoid of scales, though distinctly pubescent. Elytra long, parallel, piceous with the extreme base rufous to rufotestaceous with the lateral margins and tips piceous, evenly covered with white scales; punctures moderate in size, distinctly in rows, the rows spaced more or less evenly from the suture to the side margin; tips internally obliquely truncate, the outer angle with mucro, the inner broadly rounded. Underparts as usual with the lateral parts densely scaly. Legs pale with greenish tinge; posterior tibiæ with subapical notch. Length, 7 to 8.5 millimeters.

*Male*.—Terminal abdominal tergite very broad and deeply cut out so that the lateral horns are very slender. These horns are bent under and are widened into hooked chisel-like blades. The center portion of the segment is slightly produced and broadly rounded.

*Female*.—Fifth sternite very broadly and shallowly emarginate, the emargination commencing near the lateral margin. Sixth sternite simple, unmodified.

Type, a male from Mount Maquiling, Laguna Province, Luzon, (Baker 11546); paratypes, males and females, Mount Maquiling, (Baker 1655, 1656, 11546).

*Callimerus bakeri* Chapin. Plate 5, fig. 47.

*Callimerus bakeri* CHAPIN, Proc. Biol. Soc. Wash. 35 (1922) 134.

Form, size, and superficial appearance much as in *C. luzonicus* Chpn. Frontal region including clypeus rather densely punctured, occiput and vertex smooth and shining. Eyes margined in front with white scales, which are continued in a band across the punctured portion of the front. Thorax urn-shaped, the basal transverse impression bordered behind by a sharply raised ridge, anterior impression broad and shallow, with numerous very fine transverse striæ, especially toward the middle; lateral dilations moderate, lateral foveæ broad, circular, and shallow; punctures fine and sparse. Scutellum truncate behind. Elytra long, lateral margins almost parallel, apices obliquely truncate, the outer angle of the truncature with a rather conspicuous mucro; punctures rather fine, arranged in longitudinal rows, the rows becoming closer together as the lateral margin is approached but without the conspicuous crowding of rows 4 to 6 as in *C. lateralis* Chpn.; scales yellowish white, evenly

distributed over the elytral surface; the flanks of the elytra are slightly darker than the disk. Underparts heavily scaled along the sides, abdominal sternites moderately closely punctured.

*Male*.—Terminal tergite with a broad median triangular lobe which is subacute at apex. Laterally, the segment is prolonged into a thin, flat ramus on each side, which ends in an upwardly directed thornlike triangular process. The lobes of the penis sheath end in short, outwardly directed hooks. Fifth and sixth sternites transverse, nearly straight. Length, 6.5 millimeters.

*Female*.—Fifth sternite with a very broad and shallow emargination, the width of the emargination about equal to one-half the width of the sclerite. Length, 8 millimeters.

Type, a male from Butuan, Agusan Province, Mindanao (*Baker 17541*). Paratypes from Mindanao, as follows: A female from Surigao, Surigao Province (*Baker 14726*); a female from Iligan, Lanao Province (*Baker 12736*), and 4 males and 3 females from Surigao, Surigao Province (*Baker*); 3 females from Butuan, Agusan Province. Type in my collection; paratypes in collections of Baker and myself.

*Callimerus basilanicus* Chapin. Plate 4, fig. 40; Plate 5, fig. 52.

*Callimerus basilanicus* CHAPIN, Proc. Biol. Soc. Wash. 32 (1919) 281.

Similar in size and form to *C. lateralis*. Head shining, finely and sparsely punctured, the epistoma, frons, and region about the eyes thickly covered with white scales. Thorax greenish, dilated at the sides, anterior constriction shallow, posterior deep, well defined; lateral depressions round, shallow but distinct; surface with a few fine punctures and in the vicinity of the lateral depressions with fine wrinkles; along the sides of the disk there are a few white scales. Elytra black, punctures definitely in rows as in *C. lateralis*, well covered with scales except for the following: On each elytron near the base a rectangular patch which is continued as a fine line along the second row of punctures; the suture; the intervals between the fourth, fifth, and sixth rows almost to the apex where there is a second patch; the interval between the seventh and eighth rows, and this stripe joins the preceding at the humerus and at the apical rectangular patch; the apices are hardly truncate, but there is a mucro at the middle of each apical margin. Underparts as in the preceding species. Legs pale, femora greenish; posterior tibiae with subapical notch. Length, 6.5 millimeters.

*Male*.—Terminal abdominal tergite very broad, very broadly and shallowly emarginate, the lateral portions revolute. There

is a slight trace of a third ramus in the form of a minute triangular projection at the middle of the emargination.

*Female*.—Unknown.

Type, a male from Basilan (*Baker* 11529).

*Callimerus intermedius* sp. nov. Plate 5, fig. 51.

Form and size of *C. basilanicus* Chpn. but with differently colored scales and with male genitalia somewhat between that species and *C. lateralis* Chpn. Head finely and rather densely punctured on clypeal region and occiput, smooth and shining on frons and vertex; color of head, antennæ, and trophi rufotestaceous, tips of the mandibles dark, front sparsely scaled, eyes in front bordered with scales. Thorax much as in *C. bakeri* Chpn., but with lateral dilations a bit more prominent and with the anterior transverse impression with fewer and coarser striæ; color grass green, the pigment not very evenly distributed and apparently on the undersurface of the chitin. Scutellum with a small shallow notch behind. Elytra long and narrow, sides slightly convergent behind, apices internally obliquely truncate, angles of truncature without mucrones. Striæ 4 to 6 (from suture) crowded. Scales evenly distributed over entire surface, interspaces 5 and 6 not nude. Underparts rather densely and finely punctured, flanks heavily scaled. Legs mostly grass green, hind tibiæ with subapical notch. Length, 6.7 millimeters.

*Male*.—Terminal abdominal tergite trilobed, the median lobe almost an equilateral triangle, the lateral lobes about twice as long and subacute at tips. Fifth sternite broadly and shallowly emarginate. Sixth sternite bilobed, the notch between the lobes twice as wide as deep.

*Female*.—Unknown.

Type, a male from Surigao, Surigao Province, Mindanao (*Baker*).

*Callimerus lateralis* Chapin. Plate 1, fig. 7; Plate 3, fig. 25; Plate 4, fig. 42; Plate 5, fig. 49.

*Callimerus lateralis* CHAPIN, Proc. Biol. Soc. Wash. 32 (1919) 230.

Similar in form and appearance to *C. luzonicus*. Head smooth, shining, sparsely and moderately finely punctured. Thorax somewhat dilated, anterior and posterior depressions distinct; punctuation moderately coarse and sparse, the entire thorax free from scales; in the type the thorax is deeply suffused with green, traces of which appear in some of the other specimens. Elytra

long, narrowed toward the tips; punctures in rows, the fourth, fifth, and sixth rows close together, taking up space equal to the interval between the first and second; surface densely and evenly covered with yellowish white scales except for the interval between the fourth and sixth rows of punctures; tips of elytra truncate, slightly obliquely, neither angle with mucro. Underparts shining and finely punctured, densely clothed with scales along the sides. Legs pale, femora quite greenish; posterior tibiae with subapical notch. Length, 6 to 8 millimeters.

*Male*.—Terminal abdominal tergite broad and trifurcate, the three prolongations triangular and nearly of even length.

*Female*.—Fifth sternite much as in *C. princeps*, but lobes longer proportionally and with a fringe of more and finer hairs. Sixth sternite unmodified.

Type, a male from Basilan (Baker 11530). Paratypes: A female from Basilan (same data as type); two males from Zamboanga, Zamboanga Province, Mindanao (Baker 7279); a male from Dapitan, Zamboanga Province, Mindanao (Baker 11547); a female from Iligan, Lanao Province, Mindanao (Baker 6077); and a female from Davao, Davao Province, Mindanao; other specimens from Basilan (Baker 11876), Dapitan (Baker 14728), Kolambungan, Lanao Province (Baker 14730), and Butuan (Baker).

*Callimerus gratiosus* Gorham. Plate 4, fig. 34; Plate 5, fig. 58.

*Callimerus gratiosus* GORHAM, Cist. Ent. 2 (1876) (1875-1882) 66.

Oblong, parallel. Head with fine and coarse punctures intermingled, frons densely clothed with white scales; antennæ and mouth parts, except for tips of mandibles, pale. Thorax sparsely set with coarse round punctures, longer than broad (28-25), somewhat constricted before and behind the lateral dilatations which are rather feeble; there are broad basal and apical transverse bands of white scales, these bands broken slightly on the disk. Elytra deep violet-blue, each with six patches of white scales; the first spot partly surrounds the humeral callus, the second is small, on the suture directly behind the densely scaled scutellum, the third is transversely oblong, reaching the lateral margin but failing the suture, the fourth is small, nearly circular, close to the sutural end of the third and almost joins it, the fifth is arcuate, postmedian, almost attaining both suture and lateral margin, its convexity directed forward, the sixth is subapical, nearly oblong, with the internal basal angle continued a short distance along suture; punc-

tures of elytra very large and crowded, those at the middle of the length polygonal in shape; apices truncate with small mucro on external angle of truncature. Underparts shining, finely punctured, laterally covered with scales. Legs pale, the posterior femora and tibiae with darker patches; fifth segment of all tarsi darker; posterior tibiae without apical notch. Length, 8 millimeters.

*Male*.—Terminal tergite with a shallow notch at its extremity. Sixth sternite deeply triangularly emarginate. Valves of penis sheath acutely triangular in lateral view.

*Female*.—Fifth sternite very slightly emarginate, sixth simple.

This species was described by Gorham from specimens collected by Semper in "East Mindanao." I have seen specimens from Zamboanga, Zamboanga Province, Mindanao (Baker 7281); Butuan, Agusan Province, Mindanao (Baker 17589); and Basilan (Baker 11879).

*Callimerus fenestratus* Chapin. Plate 4, fig. 31; Plate 5, fig. 53.

*Callimerus fenestratus* CHAPIN, Proc. Biol. Soc. Wash. 32 (1919) 232; HELLER, Philip. Journ. Sci. 19 (1921) 532, pl. 1, fig. 4.

Elongate, parallel; blue, decorated with lines of white scales, antennae and legs pale. Head sparsely and distinctly punctured, except for a smooth space on vertex; frons and epistoma densely clothed with white scales. Thorax hardly dilated at sides, the anterior constriction very feeble, the posterior more sharply defined, submarginal; sides of front densely covered with scales as is the entire base; the nude part behind anterior constriction very coarsely and sparsely punctured, and shiny between the punctures; in front of anterior constriction the surface is transversely wrinkled and minutely punctured. Elytra parallel almost to tip where they are suddenly narrowed; punctuation very coarse, moderately dense; surface between the punctures alutaceous; color blue with white scales as follows: Four transverse bands, one basal, a second at basal fourth, the third at apical two-fifths, and the last subapical; these bands are connected, one to another, by longitudinal stripes, the first to the second by the suture, the second to the third by two, one on each elytron about halfway between suture and margin, and the third to the fourth by the suture, the sutural angles in all cases rounded; tips remotely subtruncate, without mucro. Underparts very dark piceous, laterally with scales. Legs pale

testaceous, each tibia with a darker stripe; posterior tibiæ without subapical notch. Length, 6.5 millimeters.

*Male*.—Terminal tergite simple, rounded, not perceptibly widened, very slightly emarginate at tip.

*Female*.—Unknown.

Type, a male from Puerto Princesa, Palawan (*Baker* 4272).

*Callimerus albus* Chapin. Plate 4, fig. 36.

*Callimerus albus* CHAPIN, Proc. Biol. Soc. Wash. 32 (1919) 233.

Elongate, parallel; black, almost entirely covered with white scales. Head so densely clothed with scales that the surface is entirely concealed; eyes black, very conspicuous; antennæ and mouth parts pale testaceous. Thorax somewhat dilated at sides, entirely covered with scales. Elytra black, coarsely and sparsely punctured, at least where the punctures show; entirely and very densely covered with snow-white scales except for four small roundish spots, two median lateral and two subapical; tips of elytra internally obliquely truncate, the outer angle mucronate. Underparts as usual. Legs pale testaceous, posterior tibiæ without subapical notch. Length, 5.5 millimeters.

*Male*.—Terminal abdominal tergite entire, somewhat dilated, fringed with rather long hairs. The median part is prolonged, perhaps, a slight distance beyond the lateral portions.

*Female*.—Unknown.

Type, a male from Basilan (*Baker* 11520).

*Callimerus bisoconotatus* sp. nov. Plate 4, fig. 44.

Form and size of *albescens* Chapin, to which it is related. Color black except for epistomal region, trophi, antennæ, and legs, which are pale. Body above almost covered with white scales, leaving on the thorax a median line and spot, and on each elytron leaving eight scaleless spots. Head, especially on frons, very densely covered with white scales, so far as can be ascertained, sparsely and finely punctured; antennæ long, the terminal three segments more elongate than usual. Thorax longer than broad (54–43), anterior half transversely striate, with a few coarse punctures, the median line in basal half smooth, impunctate, anterior transverse impression feeble, basal impression deep, distinct, and angulate at median line, the apex of the angle directed cephalad; lateral dilations moderately prominent. Elytra with lateral margins almost parallel, apices internally obliquely truncate, outer angle mucronate; punctures

coarse and moderately closely placed, not forming definite lines; suture with very narrow bead; scales dense, the following spots nude: A humeral spot including the humeral callus and extending a short distance obliquely toward the suture and directed posteriorly, at basal fourth two of these, the marginal spot triangular, its base parallel to margin and altitude less than half the base, and the sutural spot oval, its long axis running parallel to the long axis of the elytron; at just before the middle is a small transverse oval spot, about halfway between suture and margin; slightly postmedian are two large, almost round spots, nearly joined, the outer spot the larger; at apical fifth is a rectangular spot reaching from the lateral margin to about the middle of the width of the elytron; lastly, there is a small subapical, nearly round spot. Underparts finely and densely punctured, flanks thickly clothed with white scales. Posterior tibia without subapical notch. Length, 7 millimeters.

*Male*.—Terminal abdominal tergite evenly rounded, fringed with long hairs. Fifth sternite straight, the lateral posterior angles slightly produced. Sixth sternite with a deep broadly triangular emargination, the width of the emargination about half total width of segment.

*Female*.—Unknown.

Type, a male from Butuan, Agusan Province, Mindanao (Baker 17590).

*Callimerus persimilis* Chapin. Plate 5, fig. 56.

*Callimerus persimilis* CHAPIN, Proc. Biol. Soc. Wash. 35 (1922) 133.

General appearance, form, and size as in *C. albescens* Chapin, from which the present species differs markedly in the genital characters. Black, almost entirely clothed above with white scales; legs, antennæ, mouth parts, and sometimes abdomen pale. Head, except for the labrum and underside, very densely clothed with scales, finely alutaceous above, smooth beneath, antennal club very lax, terminal segment oval. Thorax almost cylindrical; apical and basal transverse impressions broad and shallow; lateral dilations feeble, the width at extreme base being almost equal to the width across them; on the disk is a shallow depressed area followed by a smooth median line which reaches to the basal marginal bead; surface, except on the smooth line, with coarse, scattered punctures. Elytra with the punctures of basal half arranged in rows; these rows fail entirely beyond

apical fourth; surface as it appears at the nude spots finely alutaceous, almost entirely covered with white scales, the scales being absent at almost the same places as in *C. albescens*. Underparts finely wrinkled, laterally with white scales. In one specimen, a female, the abdomen is pale. Legs long and slender, claws with small basal lobe, almost simple; hind tibia without subapical notch. Length, 6.5 to 7.5 millimeters.

*Male*.—Fifth abdominal sternite with a broad and shallow emargination, sixth sternite similar to fifth, terminal tergite evenly rounded, lobes of penis sheath with external hooklike processes on external side.

*Female*.—All sternites with simple, unmodified margins.

Type, a male from Surigao, Surigao Province, Mindanao (Baker 16293). Paratypes, one male and two females from Surigao (Baker 14725) and one female from Kolambungan, Lanao Province, Mindanao (Baker).

*Callimerus albescens* Chapin. Plate 4, fig. 45; Plate 5, fig. 55.

*Callimerus albescens* CHAPIN, Proc. Biol. Soc. Wash. 32 (1919) 232.

Elongate, parallel; black, almost evenly but sparsely covered with scales; legs paler. Head black, without visible punctures, evenly and sparsely clothed with scales, these slightly denser near the eyes; mouth parts and antennæ pale testaceous. Thorax with sides slightly dilated, with a depression just before the middle of the base, apical transverse impression obsolete, sides with lateral depressions; surface evenly and sparsely scaly. Elytra parallel, closed, narrowed toward tips, coarsely punctured and strongly alutaceous, almost reticulate; sparsely clothed with scales except for the humeri and a median and subapical spot on each; tips internally obliquely truncate, neither angle mucronate. Underparts of thorax black, finely punctured, the lateral portions densely scaly. Abdomen pale brown, with dense covering of scales along sides. Legs brownish testaceous, posterior tibiæ with hardly a trace of subapical notch. Length, 8 millimeters.

*Male*.—Sixth sternite bilobed, each lobe almost semicircular, valves of penis sheath curved at tips and ending in small knobs. Tip of penis directed posteriorly and ending in a round knob.

*Female*.—All abdominal sternites simple, unmodified.

Type, a female from Zamboanga, Zamboanga Province, Mindanao (Baker 6696); also a male from Davao, Davao Province, Mindanao (Baker).

*Callimerus flavus* Chapin. Plate 4, fig. 35; Plate 5, fig. 57.

*Callimerus flavus* CHAPIN, Proc. Biol. Soc. Wash. 32 (1919) 233.

Rather small and slender, parallel. Head densely covered with yellowish scales, so that the sculpture is completely obscured; antennæ and mouth parts, except for tips of mandibles, pale; antennal club rather longer than usual. Thorax longer than wide, sides parallel before and behind lateral dilation which is slight; surface with a few large round punctures, evenly and densely clothed with yellowish scales. Elytra almost entirely covered with scales but certain portions (as shown in the figure) more densely clothed than the rest, so that the insect appears to have a yellowish pattern on a yellowish brown base; punctures of elytra, so far as they are visible, large and tending to form rows; apices rounded, neither truncate nor mucronate. Lateral portions of underparts densely clothed with white scales. Legs pale, posterior tibiæ without subapical notch or comb.

*Male*.—Terminal abdominal tergite entire, rounded, very slightly wider than ventral, fringed with long hairs. Sixth sternite narrow, bilobed, the emargination triangular and rather shallow. Valves of penis sheath slender and straight.

*Female*.—Unknown. The female specimen mentioned in the original description of this species proves on further examination to be a male. The abdomen is completely collapsed and partially telescoped.

Type, a male from Mount Banahao, Luzon (*Baker* 7278); paratype, a male from the same locality (*Baker* 8290).

*Callimerus pulchellus* Gorham. Plate 4, fig. 38; Plate 5, fig. 54.

*Callimerus pulchellus* GORHAM, Cist. Ent. 2 (1876) (1875-1882) 67.

Form oblong; color brown to black, rather densely covered with white scales, antennæ, mouth parts, and legs pale. Head brown, alutaceous, with a few large punctures, thickly clothed with white scales above the clypeus; clypeus with a few scales at base; antennæ rather long, club lax. Thorax with rather prominent lateral dilations, anterior transverse impression well marked at sides, less so on disk; basal impression very deep and distinct on disk; basal marginal bead broad and well elevated; surface finely wrinkled, the disk with a smooth area on basal half; there are also two smooth areas outside of this, the intermediate space filled with coarse punctures which are resumed again on the flanks; the punctured areas bear white scales. Elytra tapering slightly toward apex, suture closed, tips internally obliquely truncate, angles rounded, not mucronate; each

elytron with six denuded areas, as follows: A spot on the humeral callus and a subscutellar spot, which sometimes coalesce; a pair of spots at basal third, in a line at right angles to the suture the outer spot the smaller; behind these are two, the first submarginal at apical two-fifths, the second in apical fourth, more or less like a J with the hook toward the margin. The margin and suture are narrowly nude. Surface alutaceous with rather large and somewhat regularly spaced punctures. Underparts brown to black, finely wrinkled and punctured, lateral margins with white scales. Legs long and slender. Length, 7 to 8 millimeters.

*Male*.—Fifth sternite very deeply and broadly, arcuately emarginate; sixth with semicircular emargination occupying the middle third of the width; parapenes straight, obliquely truncate at tips. Terminal tergite subtruncate.

*Female*.—Fifth sternite with a median V emargination.

Surigao, Mindanao (*Baker 14727, 16294*), Butuan, Mindanao (*Baker 4273*).

The species was described from eastern Mindanao, hence the above localities very nearly coincide with the type locality.

*Callimerus schultzei* Schenkling. Plate 4, fig. 33.

*Callimerus schultzei* SCHENKLING, Philip. Journ. Sci. § D 8 (1913) 303.

Form moderately elongate and convex. Brown, with white scales. Head shining, very feebly wrinkled and with a few fine punctures, near eyes rather thickly clothed with white scales; antennæ testaceous, the basal segment darker, club very feebly formed, all segments longer than broad; mouth parts castaneous. Thorax almost cylindrical, anterior transverse impression broad and shallow, almost obsolete, disk with a few coarse punctures, its anterior half with fine transverse wrinkles, lateral dilations feeble, lateral foveæ obsolete, lateral portions clothed with white scales, these absent from the lateral dilations and discal stripe, basal marginal bead broad and well elevated. Elytra with moderately coarse punctures, the surface between the punctures alutaceous, suture closed, tips obliquely internally truncate, not mucronate; surface entirely covered with scales except for the sutural bead and lateral margins, a spot on each commencing at the humeral callus and running posteriorly nearly to basal fourth where it turns and runs at right angles nearly to suture; at the middle and common to both elytra is a diamond-shaped figure inclosing a spot of scales, its apices lying on the suture and almost on the lateral margins; lastly, at apical fourth, there

is on each elytron a transverse bar starting at lateral margin and reaching almost to suture. Underparts finely wrinkled, laterally with white scales. Legs long and slender, pale. Length, 7 millimeters.

*Male*.—Unknown.

*Female*.—All ventral abdominal segments apparently simple.

Mount Maquiling, Laguna Province, Luzon (*Baker 1152*).

I have seen but the one specimen, a female, the abdomen of which is distorted so that a complete examination of the segments is impossible.

*Callimerus trifoliatus* sp. nov. Plate 4, fig. 37.

A small delicate species. Head, thorax, and underparts brown; elytra piceous; antennæ, mouth parts, and legs pale. Head almost impunctate, with very fine wrinkles; scales moderately densely placed near eyes, on clypeus and on vertex; otherwise rather sparse. Thorax almost cylindrical, lateral dilations feeble, anterior transverse impression very shallow, nearly obsolete, basal deep and distinct, basal marginal bead broad and well elevated; disk with a smooth median longitudinal line, otherwise moderately densely punctured, the punctures large and small mixed; except for median line, moderately densely clothed with white scales. Elytra long and slender, suture closed almost to tips which are internally obliquely rounded, neither angle mucronate; surface alutaceous with deep and sparse punctures placed somewhat in rows, especially on basal half, most of surface set with white scales, these absent on the following spots: The humeral callus and a subscutellar spot; two spots, the sutural twice the size of the marginal, at basal fourth, the marginal connected with the humeral by a narrow line; a large spot postmedian which is deeply indented before and behind and connected with the sutural spot of the preceding; an irregular spot at apical fourth; and a subapical spot, the last small. The suture and margins are also nude. Underparts alutaceous, laterally clothed with white scales. Legs long and thin, tarsal claws almost simple. Length, 6 millimeters.

*Male*.—Unknown.

*Female*.—All ventral segments apparently unmodified.

Type, a female from Sibuyan (*Baker*).

## CLERINÆ

*Subfamily characters.*—Cleridæ; eyes emarginate anteriorly, the emargination variable in size, antennæ eleven-segmented, filiform or with the segments beyond the fourth wide, subtriangular, usually with a more or less well defined club; thorax variable in form, usually without cariniform lateral margins, anterior coxal cavities open more or less widely behind; elytra occasionally abbreviated; abdomen with the sixth sternite small; legs moderate to long, the femora often clavate, tarsi five-segmented, the first (in the Philippine genera) small and covered by the second, second usually the longest, claws simple or with a basal tooth, never tripartite.

The largest of all the subfamilies of the family and the most difficult in which to define generic limits. This is especially true of the *Stigmatium-Thalerocnemis* complex. In his original paper, Kuwert apparently accepts the following genera: *Pseudoclerops* duVal, *Stigmatium* Gray, *Operculiphorus* Kuw., *Dasyceroclerus* Kuw., and *Placocerus* Klug. The first stands alone; the second includes the subgenus *Astigmus* Kuw.; the third stands alone and is based on a single species with exaggerated male sexual characters; the fourth includes, besides the typical subgenus, five subgenera as follows: *Chlorocnemis* Kuw. (renamed *Thalerocnemis* by Lohde), *Rhytidoclerus* Kuw., *Xestonotus* Kuw. (for which *Xestoclerus* nov. nom. is here proposed since Kuwert's name is antedated by *Xestonotus* Leconte 1853), *Phaeocyclotomus* Kuw., and *Cyclotomocerus* Kuw. The last, with its subgenus *Cardiostichus* Quedf., does not concern us here, all the species being African.

Schenkling<sup>2</sup> places *Pseudoclerops* as a subgenus of *Stigmatium*, retaining *Astigmus* as originally assigned. All of the subgenera of *Dasyceroclerus* are raised to generic rank. In his later work<sup>3</sup> *Pseudoclerops* is restored to generic rank, *Stigmatium* is left in other respects as in 1903, *Thalerocnemis* is made a subgenus of *Dasyceroclerus*, while the others are continued as valid genera. In the present paper, *Operculiphorus* is recharacterized in order that undue weight may not be placed on a secondary sex character; *Pseudoclerops*, *Cyclotomocerus*, and

<sup>2</sup> Gen. Ins. (Wytsman) (1903).

<sup>3</sup> Col. Cat. (Junk) (1910).

*Astigmus* are extralimital but may be discovered in the Philippines at a later date. *Rhytidoclerus*, *Dasyoceroclerus*, *Thalerocnemis*, and *Phaeocyclotomus* are maintained as distinct and all are represented in the Philippine fauna.

*Neoclerus* Lewis and *Thaneroclerus* Lef. are removed from the Clerinæ to form, together with certain extralimital genera, the new subfamily Thaneroclerinæ. Gahan 1910 is followed in assigning *Tarsostenus* Spin. to the Korynetinæ. Two new genera have been proposed for certain new species.

The genera that are known to occur in the Philippines are separated in the following manner:

*Key to known Philippine genera of Clerinæ.*

1. Eyes coarsely granulate..... 2.  
Eyes finely granulate..... 4.
2. All palpi with triangular apical segments..... *Notoxus* Fabricius.  
Labial palpi only with triangular apical segments..... 3.
3. Thorax and elytra with numerous spinelike bristles in addition to the usual vestiture; size small..... *Anthicoclerus* Schencking.  
Thorax and elytra without spinelike bristles, vestiture fine and rather sparse; size large..... *Orthrius* Gorham.
4. Base of thorax not strongly constricted, basal transverse impression remote from basal margin and rather feeble, sides of thorax not strongly dilated..... 5.  
Base of thorax strongly constricted, basal transverse impression close to basal margin and rather deep, sides of thorax dilated and rounded..... 6.
5. Form cylindrical, elytra with rows of punctures... *Omadins* Castelnau.  
Form strongly depressed, elytra irregularly punctate.  
*Pseudomadius* g. nov.  
6. Antennæ with all segments beyond the second thin, equal in width and subequal in length ..... 7.  
Antennæ with the segments toward the end becoming triangular and wider, forming a more or less distinct club..... 11.
7. Form cylindrical, not depressed..... 8.  
Form broad and depressed..... 9.
8. Form slender, elytra slightly wider just behind the middle than at base, thorax transverse ..... *Operculiphorus* Kuwert.  
Form robust, elytra parallel to about apical third from which point they narrow to apex; thorax longer than broad.  
*Dasyoceroclerus* Kuwert.
9. Elytra with rasplike punctures on basal half .... *Rhytidoclerus* Kuwert.  
Elytral punctures simple, not rasplike..... 10.
10. The stout spinelike bristles on the apical half of the elytra arise from tubercles ..... *Phaeocyclotomus* Kuwert.  
The stout spinelike bristles on the apical half of the elytra do not arise from tubercles ..... *Thalerocnemis* Lohde.

11. Large; elytra with rows of coarse, rasplike punctures on basal half.  
*Stigmatium* Gray.  
 Small; elytra without rasplike punctures on basal half.  
*Coptoclerus* g. nov.

Genus **NOTOXUS** Fabricius

*Notoxus* FABRICIUS, Syst. Ent. (1775) 158; GAHAN, Ann. & Mag. Nat. Hist. VIII 5 (1910) 66.

*Opilo* LATREILLE, Hist. Nat. Crust. Ins. 3 (1802) 111; LACORDAIRE, Gen. Col. 4 (1857) 438; SCHENKLING, Gen. Ins. (Wytsman) Cleridae (1903) 33; Col. Cat. (Junk) Cleridae (1910) 32.

*Opilus* AUCTT.

*Eupocus* ILLIGER, Mag. Insektenk. 6 (1807) 341.

As has been shown by Gahan (1910), Fabricius himself has, by elimination, fixed the type of *Notoxus* as *N. mollis* Linn. For a discussion of the technical aspects of the case, see his paper.

*Generic characters.*—Clerinæ; eyes large, prominent, coarsely granulate, semicircularly emarginate; antennæ eleven-segmented, first segment stout, bent, second cylindrical, shorter than third, third to eighth cylindrical, each shorter than its predecessor, ninth and tenth subtriangular, as broad as or broader than long, eleventh oval, subtruncate; labrum bilobed; terminal segments of both maxillary and labial palpi triangular. Thorax longer than broad, hardly constricted at base, sides feebly dilated, anterior coxal cavities open. Elytra covering the abdomen, sides parallel, tips together rounded, coarsely serially punctate. Abdomen with six visible ventral segments, legs moderately long, femora not swollen, tarsi with first segment concealed beneath the second, claws simple.

Genotype, *Notoxus mollis* (Linn.).

Geographic range, Palæarctic, Ethiopian, and Australian Regions. The type species has been reported from the United States. As yet the genus is not known from South America.

Schultze has listed *Opilo mollis*, a European species, as Philippine, probably on the statement by Gorham, 1878. If there is a species of this genus in the Islands, and doubtless there is, it will more likely prove to be *niponicus* Lewis or a related species.

Genus **ANTHICOCLERUS** Schenkling

*Anthicoclerus* SCHKLG., Deutsche Ent. Zeit. (1906) 264.

*Generic characters.*—Clerinæ; head short, front broad, eyes prominent, rather coarsely granulate, feebly and shallowly emar-

ginate; antennæ eleven-segmented, first segment short and thick, second almost as long as first but only half as thick, third half again as long as second, fourth to seventh each shorter than the preceding but of equal thickness, eighth to tenth wider than the preceding and each about as wide as long, eleventh twice as long as wide, acuminate, labrum emarginate; terminal segment of maxillary palp subulate, that of labial palp elongate-triangular, the apex very obliquely truncate. Thorax transverse, widely dilated at sides, anterior transverse impression distinct, strongly constricted at base, anterior coxal cavities open behind. Elytra covering abdomen, with rows of more or less well defined punctures. Abdomen with six visible ventral segments. Legs moderate, tarsi with second and third segments very thick, without conspicuous lobes, fourth segment short, lobed beneath, claws thin and long, simple.

Genotype, *Thanasimus anthicoides* Westw.

Geographic range, the Indo-Malayan Region.

The genus contains but one species with one variety.

**Anthicoclerus anthicoides** (Westwood). Plate 2, fig. 10.

*Thanasimus anthicoides* WESTWOOD, in White, Cat. Col. Brit. Mus., Cler. (1849) 59, Proc. Zool. Soc. London (1852) 43, pl. 27, fig. 8.  
*Thanasimus pallipes* GORHAM, Trans. Ent. Soc. London (1878) 162;  
SCHENKLING, Ent. Mitteil. 5 (1916) 221.

Form short and broad, depressed. Color piceous, each elytron with two large pale spots. Head sparsely and finely punctured, antennæ with the first two or three segments castaneous, the rest almost black; maxillary palp dark, the apex of the terminal segment slightly paler, labial palp pale. Thorax black, shining, with a few scattered punctures over the surface, the bristles on the flanks quite conspicuous. Elytra with rows of fine punctures, these rows very indistinct on the outer half of each elytron, in some specimens surface between the punctures shining, hairs and bristles moderately dense; color piceous black, each elytron with a large irregular pale spot just behind the base and another near the apex. Underparts castaneous to piceous, the first abdominal sternite paler, the surface finely and sparsely punctured, moderately clothed with brown hair. Legs moderate, black, the second tarsal segment very thick and heavy. Length, 2.5 to 3 millimeters.

*Male*.—Sixth abdominal sternite with very shallow emargination across the middle of the posterior margin. Terminal tergite broadly rounded.

Female, not seen.

Ceylon (type). Sumatra. New Guinea. Borneo. Philippine Islands, Mindanao, Davao Province, Davao (*Baker* 6700, 6697); Lanao Province, Iligan (*Baker* 13515).

The species appears to be rather variable. In a fairly long series of specimens from each of several localities there is great variation in the degree of coarseness of the elytral punctuation as well as in the amount of pubescence on the upper surface. It appears impossible to make any satisfactory split in the material.

#### Genus ORTHRIUS Gorham

*Orthrius* GORHAM, Cist. Ent. 2 (1876) (1875-1882) 74; Ann. Mus. Stor. Nat. Genova II 12 (1892) 737; SCHENKLING, Gen. Ins. (Wytsman) Cleridae (1903) 45.

*Generic characters*.—Clerinae; form elongate, parallel, sub-depressed. Head wide in front, eyes coarsely granulated and almost entire; labrum emarginate; antennae eleven-segmented, first segment stout and bent, second subglobose, about as long as thick, third to eighth moniliform, subequal, ninth and tenth transverse, each about as long as the eighth, eleventh longer than tenth, somewhat acuminate, excavate on the internal margin, terminal segment of maxillary palp cylindrical, about three times as long as wide, that of labial palp angular, broadly dilated and very obliquely truncate at tip. Thorax with length and breadth subequal, constricted at base, anterior transverse impression feeble, anterior coxal cavities broadly open behind. Elytra covering the abdomen, punctate-striate throughout their length. Abdomen with six visible sternites, in the male sex occasionally (or always ?) with profound secondary modifications. Legs moderate in length, tarsi with the first segment short, the second shorter than third and fourth together, claws slender, simple.

Genotype, *Orthrius cylindricus* Gorham.

Geographic range, Indo-Malayan and Australian Regions.

A moderately large genus of medium-sized, mostly brownish species. Of the three species before me, one appears to have

been described previously under three different names and is widely distributed. The remaining two are, to the best of my knowledge, undescribed.

*Key to species of Orthrius Gorham.*

1. Head and thorax black; each elytron with two irregular pale brown spots.  
O. binotatus Fischer.  
Head and thorax castaneous; elytra not as above..... 2.
2. Entire insect, with the exception of the eyes and hind femora, pale;  
elytra without markings..... O. pallidus sp. nov.  
Each elytron with base narrowly, sutural margin, and two transverse  
bars of dark castaneous on pale brown..... O. bicrucis sp. nov.

*Orthrius binotatus* Fischer. Plate 2, fig. 11.

*Orthrius binotatus* FISCHER, Bull. Mus. Hist. Nat. Mosc. 2 (1829)  
Ins. 44; SCHENKLING, Ent. Mitteil. 4 (1915) 248.

? *Orthrius andamanensis* SCHENKLING, Deutsche Ent. Zeit. (1906) 268,  
(1910) 103.

*Orthrius sellatus* WESTWOOD, Proc. Zool. Soc. London (1852) 42, pl.  
25, fig. 8.

Form rather broad and depressed. Color black, elytra maculate, underparts and most of legs castaneous. Head finely and rather sparsely punctured, sparsely pubescent; labrum, mouth parts, and antennæ castaneous. Thorax slightly wider than long, finely and sparsely punctured, punctures denser on flanks, pubescence sparse. Elytra with ten rows of rather fine punctures, the last row just beneath the marginal bead. Between each two rows there is an irregular row of very minute punctures, hardly visible with a (55 mm. 6 x) binocular; color black or very dark piceous, each with a large irregular spot of pale brown reaching from margin to suture and thus forming, with the corresponding spot on the other elytron, a median band; also just before the apex there is a semicircular sutural spot of the same color. Underparts very finely and rather densely punctured, sparsely pubescent. Legs castaneous, the knees and tarsi of the anterior and middle, the apical third of the femur, and the tibia and tarsus of the posterior piceous; tibiae with but one short apical spine. Length, 11 millimeters.

*Male*.—Unknown.

*Female*.—Abdominal sternites simple, unmodified.

If the above-quoted synonymy is correct, this species has a wide range. Fischer's type was from Bengal, Schenckling's from the Andaman Islands, while Westwood's material was described as from "India orientali." I have seen one Philippine specimen, from Davao, Mindanao (Baker 7284). The specimen

appears to fit the description of *sellatus* Westw. in all points noted more nearly than it does that of *andamanensis* Schklg.

*Orthrius bicrucis* sp. nov.

Form slenderer than in *O. binotatus* Fischer. Head castaneous, front shining, very sparsely and finely punctured, vertex and occiput slightly more densely punctured, epistoma with a few coarse punctures which appear to be symmetrically placed; there are nine along the frontal suture, a median transverse row of four, and six along the clypeal suture; pubescence sparse, erect, and brown. Thorax castaneus, subcampanulate, very smooth and shining, almost impunctate, there being a few punctures along each side of the disk; anterior transverse impression distinct, subangulate at middle, posterior impression deep, posterior margin beaded. Elytra with ten rows of punctures, rows 6 to 9 not crossing the humeral callus, the individual punctures distinct to extreme apex, as well as toward the suture, surface between the punctures shining; color pale brown with the following castaneous markings: The suture, the extreme base of each elytron, a transverse bar at basal third, a second transverse bar at apical third which is distinctly wider where it crosses the suture, and the apices narrowly. Underparts very densely and moderately finely punctured, pale castaneous, legs unicolorous, darker. Length, 6.5 millimeters.

*Male*.—Fifth abdominal sternite with a broad arcuate emargination, sixth sternite with a smaller but proportionally deeper emargination, the entire surface of the sixth densely covered with short spines, terminal tergite truncate with the lateral angles rounded.

*Female*.—Unknown.

Type, a male specimen from Luzon, Nueva Vizcaya Province, Imugan (Baker).

I have seen but the one specimen of this very interesting species. In appearance it approaches *O. sexplagiatus* Schklg. from the Nilgiri Hills, but may be distinguished by the punctuation of the elytra as well as by the color of the elytral markings. The short spines on the sixth sternite in this and the next species are entirely different from anything I have examined before.

*Orthrius pallidus* sp. nov.

More robust than the preceding; entirely pale brown, pubescence sparse and erect. Head finely and not sparsely punctured, on each side of the front just above the insertion of the antennæ

is a group of seven large punctures; epistoma with one large puncture at either side and a few smaller ones toward the center. Thorax finely and moderately densely punctured, the region in front of the anterior transverse impression more coarsely so. Elytra with ten rows of punctures, the sixth to the ninth failing at the humeral callosity, punctures reaching the extreme apex, surface between the punctures alutaceous, dull. Underparts alutaceous, finely punctured, and sparsely pubescent. Legs moderate, femora slightly swollen, tibiæ straight and slender, tarsi rather thick. Length, 7 millimeters.

*Male*.—Almost the same as in *O. bicrucis*; differs in that the emargination of the sixth sternite is straight across the bottom instead of being V-shaped.

*Female*.—Unknown.

Type, a male specimen from Luzon, Laguna Province, Mount Maquiling (*Baker*).

#### Genus **PSEUDOMADIUS** novum

*Generic characters*.—Clerinæ; form elongate, parallel, depressed. Head with eyes about as wide as thorax, vertex narrow, front triangular, eyes large but not prominent, finely granulated, acutely emarginate near base of antennæ, labrum so deeply emarginate as to be apparently bilobed; mandibles stout, curved, with internal tooth near apex, terminal segment of maxillary palp cylindrical, about half again as long as thick, that of labial palp very long and slender, broader toward apex and obliquely truncate; antennæ eleven-segmented, first stout, slightly curved, second globular, third to seventh elongate, equal in size and shape, eighth slightly wider and shorter than seventh, ninth to eleventh forming a compact club, ninth and tenth subequal in length and twice as wide as eighth, eleventh cultriform, its length equal to that of ninth and tenth together. Thorax quadrate, anterior coxal cavities open behind, anterior and basal transverse impression distinct. Elytra covering the abdomen, sides sinuate, apices rounded, thickly and irregularly punctured. Abdomen with six visible sternites, fifth and sixth modified in the male. Legs long, hind femora reaching well beyond apex of abdomen, femora clavate; tibiæ long and slender, first tarsal segment concealed beneath second, second long; claws with slight basal toothlike thickening.

Genotype, *Pseudomadius viridiventris* sp. nov.

*Pseudomadius viridiventris* sp. nov.

Form elongate, parallel, depressed. Front of head and underparts bright metallic green, thorax and elytra purplish black with golden pubescence, legs pale with dark markings. Head in front of the eyes rather coarsely and densely punctured, between and behind the eyes more finely and sparsely punctured; occipital region transversely rugulose, surface rather thickly set with stiff, suberect golden hairs; labrum testaceous, mandibles black, antennæ piceous, the first segment paler, palpi pale. Thorax slightly wider than long, sides parallel, disk very finely and rather sparsely, sides more densely and coarsely punctured, anterior and basal margins transversely rugulose; on either side of the median line at about basal third is a deep pit, entire surface rather sparsely set with golden pubescence. Elytra flat, covering the abdomen, lateral margins sinuate, each with distinct patches of golden hairs as follows: At the base there are three stripes extending toward the apex for a short distance, one sutural and one on either side of the humeral callosity. The median of these three stripes is continued as an irregularly triangular spot which is joined to its mate on the other elytron across the suture. These markings occupy the basal half of the length. At about apical third there is a short transverse bar across the suture, which becomes obsolete toward the lateral margins. At the apex there is an oval spot common to the two elytra but hardly reaching the lateral margins. This spot is very narrowly connected with the transverse bar along the suture. Underparts finely and rather sparsely punctured, surface between punctures alutaceous. Legs very coarsely wrinkled, femora clavate, the thickest portion toward the base, the vestiture so coarse as to be almost spinous. Length, 8 millimeters.

*Male*.—Fifth sternite broadly and deeply emarginate. Sixth sternite rather shallowly and less broadly emarginate, last tergite rounded, its margin greatly thickened.

*Female*.—Terminal tergite and all sternites simple.

Type, a male from Mindanao, Zamboanga Province, Dapitan (Baker); paratypes from Surigao (2), Port Banga (1), and Kolambungan (1), Mindanao, received from Staudinger and Bang-Haas.

Owing to the structure of the antennæ and the punctuation of the elytra this very beautiful species cannot be associated with *Omadius*. Its affinities, however, are with that genus. The

clavate femora suggest certain species of *Thalerocnemis*, but there again the antennal differences are of generic rank.

#### Genus OMADIUS Castelnau

*Omadius* CASTELNAU, Silberm. Rev. Ent. 4 (1836) 48; SPINOLA, Monog. Clérites 1 (1844) 172; LACORDAIRE, Gen. Col. 4 (1857) 465; KUWERT, Ann. Soc. Ent. Belg. 38 (1894) 62; GORHAM, Proc. Ent. Soc. London (1894) xlii.

*Ommadius* GORHAM, Ann. Soc. Ent. Belg. 39 (1895) 296, footnote; SCHENKLING, Gen. Ins. (Wytsman) Cleridae (1903) 82; Col. Cat. (Junk) Cleridae (1910) 69.

*Generic characters.*—Clerinæ; head moderate to large, eyes (in Philippine species) prominent, finely granulated, deeply emarginate, labrum bilobed, terminal segment of maxillary palp cylindro-acuminate, that of labial palp very long, slender, broadened toward apex and obliquely truncate; antennæ eleven-segmented, first segment stout, obconical, second globose, nearly spherical, third to fifth cylindrical, smooth and shining, of equal width but each shorter than the preceding, sixth to tenth triangular, each broader than the preceding but of subequal length, eleventh cultriform or oval, longer than the tenth. Prothorax longer than broad, basal and anterior transverse impressions clearly defined, anterior coxal cavities open behind. Elytra with ten rows of punctures, those near the base sometimes rasplike. Abdomen with six visible sternites, fifth and sixth sternites usually showing some sexual modification in the male. Legs long, femora not clavate; tarsi of five segments, the first lying beneath the second, second longest, third and fourth shorter, fifth as long as third and fourth together; claws with narrow triangular platelike tooth at base.

Genotype, *Omadius indicus* Castelnau, Plate 2, fig. 9.

Geographic distribution, Indo-Malayan and Australian Regions.

The above characterization of the genus is made from *O. indicus* Cast. and *O. nimbifer* Gorh., a closely related species. A study of some thirty species belonging to the genus indicates that it is impossible to give as broad a definition of the antennal form as is necessary to include all types without making the definition too broad to have meaning. The typical species fit the above diagnosis; in the case of aberrant species such as

*centralis* or *brunneus*, attention is called to those that are at variance with the above statement.

There are at present about one hundred twenty described species assigned to *Omadius*; there is no doubt that many of these so-called species will prove to be worthless. Ten of these have been reported from the region under discussion. One of these, *O. indicus*, probably does not occur here, though there is some possibility that it may be collected on Palawan or Balabac, the species being common on Borneo. It is distinguished from *O. nimbifer* (probably the Philippine species that has been reported as *indicus*) by the extremely rough disk of the pronotum. A second species, *O. posticalis* Gorh., is not known to me in nature; I have placed it in the key as best I can from the meager description available. The remaining eight, together with three which appear to be new, are before me.

*Key to Philippine species of Omadius Castelnau.*

1. Elytra reddish yellow, each with three transverse bars of purplish black; legs entirely pale..... 2.
- Elytra not as above; legs usually annulate..... 4.
2. Black bars on elytra narrow, each strongly angulate on disk, bars on the elytra connected across suture; pronotum entirely dark piceous, covered with a dense, depressed golden pubescence.
  - O. aurulentus* Heller.  
Black bars on elytra not strongly angulate on disk, each bar rounded at sutural end; suture pale its entire length..... 3.
  3. Pronotum shining black, with but a very few scattered punctures and with no depressed pubescence..... *O. vespiformis* Gorham.  
Pronotum bicolored, the posterior third and a large semicircular spot on the anterior margin black, the rest reddish yellow, surface covered with pubescence as in *aurulentus*..... *O. bakeri* Heller.
  4. Elytra piceous, at base castaneous, each with a transverse bar just before the middle, which is widest near the suture and tapers almost to a point on the lateral margin; also with an oblique bipolar spot at apical fourth, reaching from the lateral margin halfway to suture, and with the extreme apices densely covered with depressed golden pubescence; legs pale..... *O. aurifasciatus* Gorham.  
Elytra not as above; legs annulate or striped with dark..... 5.
  5. Anterior portion of pronotum smooth, finely punctured; pronotum with a deep transverse depression across disk, elytra pale brown on disk, flanks darker, and with a continuation of the dark onto the discal surface at apical third and with a subapical lunate dark spot. The pale brown portion is covered with dense, depressed silvery pubescence; tibiæ sharply annulate..... *O. brunneus* sp. nov.  
Anterior portion of pronotum transversely wrinkled or reticulate.... 6.

6. Anterior portion of pronotum transversely wrinkled; femora with apical half dark, tibiæ largely dark..... 7.  
 Anterior portion of pronotum reticulate, tibiæ narrowly annulate.... 8.

7. Elytra each with three irregular bars, the first of two spots nearly connected, the second of one large transverse spot deeply indented behind, the third oval, subapical..... *O. notatus* Gorham.  
 Elytra with a single broad fascia behind the middle.  
     *O. posticalis* Gorham.

8. Elytra dark brown, with a broad transverse bar of silvery pubescence; the apical fourth of the elytra is also decorated with similar pubescence ..... *O. centralis* (Gorham).  
 Elytra not with only a single conspicuous pale transverse bar..... 9.

9. Elytra, with the exception of the flanks, uniform castaneous, decorated with a complicated network of silvery pubescence.  
     *O. pruinosus* sp. nov.  
 Elytra dark piceous or black with basal and median transverse bars and apices broadly covered with olive-green pubescence, the apical pubescence inclosing a dark spot..... 10.

10. Subbasal transverse black spot single, not divided by longitudinal band of pale pubescence, subapical dark spot entire, oval; antennæ with segments 3 to 5 dark..... *O. nimbifer* Gorham.  
 Subbasal transverse spot double, the fifth interspace being clothed with pale pubescence, subapical spot notched behind; antennæ entirely pale ..... *O. kamelianus* White.  
 Subbasal transverse spot but half the width of the elytron, the pale pubescence covering most of the surface from the fourth interspace outward (a trace of the original spot occurs in the seventh and eighth interspaces); subapical spot reduced to two minute points; antennæ dark except for basal and apical pale segments.  
     *O. sibuyanus* sp. nov.

*Omadius vespiformis* Gorham.

*Omadius vespiformis* GORHAM, Cist. Ent. 2 (1876) (1875-1882) 103.

Head finely punctured, very sparsely so on front between the eyes, rather densely on occiput and very densely just above the epistoma; entirely pale; with a few scattered erect hairs; antennæ rather short, pale with the intermediate segments slightly darker. Pronotum as wide as long, black, highly polished, with only a few dozen setigerous punctures on either side of the median line, anterior transverse impression broad and shallow, basal impression a clean-cut groove, sides rounded between impressions. Elytra with traces of ten rows of punctures, second interspace twice as wide as sutural, individual punctures of the first, second, seventh, eighth, and ninth distinctly smaller than those of the other rows, all punctures obsolete beyond the middle, surface between punctures of rows very finely and densely punctulate; color reddish yellow, each elytron with three transverse purplish black spots. The first in basal fourth, its basal margin

nearly straight, the posterior margin irregular so that the spot is narrowest at the suture, widening rapidly until it reaches its maximum width in the fourth interspace, from whence it extends to the lateral margin with width nearly uniform; the second postmedian, narrower than the first, anterior margin angulate, similar to the posterior margin of the first, posterior margin of second slightly arcuate; the third subapical, suboval and oblique. Pubescence dense and depressed, golden on the reddish yellow portions, black on the spots. Underparts pale except for the side pieces of the mesothorax and the posterior coxae which are piceous. Punctuation rather coarse on the abdomen, finer on the thorax. Legs reddish yellow, immaculate. Length, 12 millimeters.

Sex uncertain in the specimens before me. All abdominal sternites and the terminal tergite simple.

"East Mindanao, Philippines." Two specimens from Surigao, Surigao Province, Mindanao (Baker 16172).

The only Philippine species known to me in which the usual dense, depressed pubescence on the pronotum is absent. In this character, the insect resembles *O. fasciatus* Kuw. from Celebes.

In his original description of *O. bakeri*, Heller refers to *O. vespiformis* as having "granules" on the disk of the pronotum. There is no mention of this in Gorham's original characterization of the species, nor am I able to detect any on the specimens before me.

#### *Omadius bakeri* Heller.

*Ommadius bakeri* HELLER, Philip. Journ. Sci. 19 (1921) 533.

Form parallel, depressed. Head entirely pale, finely and densely punctured, pubescence mostly erect and pale; antennæ of usual form, entirely pale. Pronotum equilateral, sides rounded between the anterior and basal transverse impressions, anterior impression obsolete across disk, basal complete, clearly defined; surface densely and finely punctured on disk, more sparsely on flanks, pubescence moderately dense and depressed; color reddish yellow, the basal third and a transverse interocular spot on the anterior third black. Elytra almost the same as in *O. vespiformis* Gorh. but with the fine punctures slightly more densely placed and with slightly different markings; the first spot does not extend across the suture, but ends in the second interspace; the second spot also fails the suture and is more excavate on its posterior margin; the subapical spot is similar in shape to that of *vespiformis* but is smaller and more clearly

defined. Lateral portions of the mesosternum and the posterior coxae are black, otherwise the underparts are reddish yellow. The metathorax is finely and densely punctured, the abdomen very sparsely so; the femora are finely rugose. Length, 12 millimeters.

Specimens of but one sex are before me; the abdominal sternites are simple.

"Luzon, Laguna Province, Mount Maquiling (1974)." Two specimens from the same lot received from Professor Baker.

*Omadius aurulentus* Heller.

*Ommadius aurulentus* HELLER, Philip. Journ. Sci. 19 (1921) 533, pl. 1, fig. 10.

Form elongate, depressed, slightly attenuate posteriorly. Size large. Head in front finely and densely punctured, occiput irregularly transversely rugulose, front densely clothed with rather long golden pubescence; antennae of usual form, entirely pale. Pronotum piceous, densely and finely punctured above, flanks almost impunctate, anterior transverse impression broad and deep, basal broad and shallow, polished; disk rather densely clothed with golden pubescence. Elytra with ten rows of punctures which become obsolete at about the middle of the length, pale reddish yellow with three undulating black bars, the first and narrowest before the middle, the second postmedian, the third subapical, the second and third almost equal in width; pubescence fairly equally distributed over the surface, that arising from the black bars black, that from the reddish yellow portions golden. Underparts mostly reddish yellow, the pro- and mesosterna piceous, thoracic sclerites finely and densely punctured, the abdomen sparsely so. Legs reddish yellow, tibiae slightly darker. Length, 16 to 17 millimeters.

*Male*.—Fifth and sixth abdominal sternites transverse, feebly emarginate, terminal dorsal broadly and somewhat deeply so.

*Female*.—Fifth sternite with a small U-shaped emargination. Sixth almost entire, terminal dorsal rounded.

Mount Maquiling, Laguna Province, Luzon. A pair of this fine species sent me by Baker under his No. 11545, five specimens from Mount Banahao, two from Mount Isarog, and one from Imugan received from Staudinger and Bang-Haas.

*Omadius aurifasciatus* Gorham.

*Ommadius aurifasciatus* GORHAM, Cist. Ent. 2 (1876) (1875-1882) 102.

Form cylindrical, depressed, tapering behind. Head rugose-punctate on front, transversely rugose on occiput, labrum and

clypeus pale, impunctate, epistoma with a few large punctures at sides; antennæ of usual form, entirely dark. Pronotum entirely pitchy, sides nearly straight, wider anteriorly, anterior transverse impression broad and rather deep, basal clean-cut; on the disk is a short median longitudinal groove extending from the anterior impression halfway to basal, anterior portion coarsely and sparsely punctured, disk with two patches of fine, densely placed punctures, otherwise sparsely and somewhat coarsely punctured; pubescence from fine punctures greenish golden, otherwise dark. Elytra with coarse rasplike punctures at base, puncture rows becoming obsolete at median transverse fascia; color piceous, humeri ferrugineous, each elytron with three patches of greenish golden pubescence as follows: The first in the form of a transverse bar, widest at fourth puncture row, posterior margin straight; the second comma-shaped, starting at the middle of the elytron at the apical third and extending outward and apically to the lateral margin; in the third the apices are narrowly covered with the pubescence. Underparts and legs dark ferrugineous, posterior coxae piceous. Length, 12 to 14 millimeters.

*Male*.—Terminal abdominal tergite with a broad shallow emargination, sternite simple.

*Female*.—Fifth abdominal sternite with a small, semicircular emargination; sixth sternite entire; terminal tergite emarginate.

"East Mindanao, Philippines." Two specimens before me from Iligan, Lanao Province (*Baker 12742*), and Butuan, Agusan Province (*Baker 17587*), both localities in Mindanao.

*Omadius centralis* (Gorham).

*Stigmatium centralis* GORHAM, Cist. Ent. 2 (1876) (1875-1882) 94.

Form depressed, approaching that of *Stigmatium*. Head between and below the eyes reticulate, on occiput transversely rugulose, sparsely pubescent. Color piceous except for frons which is pale. Epistoma with a few very large punctures. Antennæ with the sixth to eighth segments hardly dilated, ninth distinctly smaller than tenth, tenth and eleventh together forming a short oval club; first segment and apical half of eleventh segment pale. Pronotum longer than broad, wider in front, anterior transverse impression indistinct, basal as usual, anterior portion finely reticulate, disk very finely and densely punctured, median transverse impression very feeble but present, connecting the lateral foveæ, surface densely covered with depressed pale pubescence.

Elytra with ten rows of punctures which extend to apical fourth, the second and fourth interspaces each wider than either the sutural, third, or fifth; color piceous; on the second fourth of the length is a broad transverse fascia of pale depressed pubescence, complete across suture, very narrow at lateral margins, with anterior and posterior margins nearly straight; at apical fourth there is a narrow undulating crossbar which is connected with the apical pubescent patch by a narrow sutural line of pubescence. Underparts of thorax piceous, abdomen reddish yellow. Apical third of femora dark with subapical narrow pale annuli; tibiæ annulate at base and at middle with dark; tarsi pale. Length, 7.5 to 8.5 millimeters.

*Male*.—Sixth abdominal sternite feebly emarginate, the depth of the emargination varying.

*Female*.—Sternites simple.

"East Mindanao, N. E. Luzon." Material before me as follows: Mount Maquiling, Laguna Province, Luzon (*Baker 582, 1975, 3038*); Malinao, Tayabas Province, Luzon (*Baker 6082*); Negros (collector unknown, specimens received from Dr. K. Jordan); Surigao, Surigao Province, Mindanao (*Baker 16171, 17586*).

There is some slight variation among the specimens, but it does not appear to be correlated with distribution. The above diagnosis is taken from a Surigao specimen which fits the original description in all particulars.

*Omadius brunneus* sp. nov.

Form cylindrical, depressed; size rather small for the genus. Head very finely punctured, below the eyes very densely, between and above them very sparsely; interocular carina very sharply defined, pubescence sparse, depressed, pale; color castaneous, labrum and epistoma testaceous; antennæ castaneous, the first two segments pale, seventh to tenth segments very feebly triangular, nearly circular in cross section, eleventh as long as three preceding, flattened. Pronotum somewhat more constricted at base than is usual in the genus, anterior and basal transverse impressions narrow and distinct, a deep and broad transverse groove across the middle which ends at either side near two conspicuous pits, surface very finely and sparsely punctured, pubescence moderately dense, depressed, pale yellow; color castaneous, flanks slightly darker. Elytra with ten rows of punctures on each, the punctures of the first and second rows

smaller than those of the succeeding rows, sixth and seventh rows the longest, reaching to about apical fifth, tenth row short, hardly exceeding the middle of the length. The space inside the sixth row on the basal half is pale yellow-brown, as is also most of the apical fourth. Outside the sixth row the color is dark castaneous with one or two small spots of paler brown; just beyond the middle the dark color is extended toward the suture as a narrow bar which reaches the second row of punctures and then runs apically a short distance between the second and fourth rows. This transverse bar is also extended apically for a short distance along the sixth and seventh rows. There is a small transverse dark spot on the apical pale portion. Pubescence fine and depressed, colored as the surface from whence it arises. Underparts finely and densely punctured, pale yellowish. Legs pale, the apices of the femora and an annulus on each tibia dark, tarsi slightly darker than rest of legs. Length, 6 millimeters.

Type, a specimen (sex undetermined) from Mount Banahao, Luzon (*Baker*).

This species, while quite atypical of the genus, does not present characters of sufficient importance to warrant the erection at this time of a new genus to contain it.

*Omadius pruinosus* sp. nov.

Form of *O. notatus* Gorh. Size rather small for genus. Head moderate, finely and densely punctured, sparsely pubescent except around eyes; antennæ normal for the genus, terminal segment as long as four segments preceding, apical half pale; interocular carina entirely absent. Pronotum slightly longer than broad, widest just before the middle, anterior and basal transverse impressions distinct, median transverse impression very feeble and indistinct, surface finely and densely punctured, finely reticulate anteriorly, rather densely pubescent, the pubescence strongly depressed. Elytra with rows of rather small punctures, surface very densely clothed with short, depressed pubescence of two colors. The greater part of the surface is covered with dark brown hairs which show a slight iridescence. On the basal half and toward the apices there are a few irregular lines of silvery pubescence forming a very intricate but quite indefinite design. The entire upper surface of the insect is dark castaneous, the flanks of the thorax and elytra piceous. Underside of thorax castaneous, finely alutaceous, and sparsely pubescent. Abdomen pale yellow-brown, finely and sparsely punc-

tured, the surface between the punctures alutaceous. Legs pale, the femora annulate just before the apices, the tibiæ annulate both at the base and at the middle; tarsi rather dark. Length, 7 millimeters.

Type, a specimen (sex undetermined) from Mount Banahao, Luzon (*Baker 3037*).

The sculpture of the pronotum is by far the least pronounced of any species with the reticulate anterior margin. The insect, in fact, is the most delicately formed and graceful of the species known to me. It appears to have no near relatives in the Philippines.

**Omadius notatus Gorham.**

*Omadius notatus* GORHAM, Cist. Ent. 2 (1876) (1875-1882) 103.

Form cylindrical, depressed, slightly tapering posteriorly. Head very densely and finely punctured, front thickly clothed with long pale hairs, eyes very prominent, interocular carina short, blunt, rather low down on front, epistoma with a few very large, more or less lozenge-shaped punctures, labrum and first antennal segment pale, rest of antenna piceous. Pronotum densely and evenly clothed with fine depressed pale pubescence, anterior and basal transverse impression distinct, median transverse impression obsolete, anterior portion with coarse transverse ridges, color piceous. Elytra with ten rows of punctures, the punctures themselves becoming indistinct just beyond the middle of the length, tenth row as long as ninth, all rows continued as grooves nearly to apex; surface very minutely punctate, pubescence moderately dense and depressed; each elytron with three dark spots, on which the pubescence is black, as follows: One just before basal third, transversely oval, reaching from the first to the tenth puncture rows and crossed by a very narrow bar of pale pubescence in the sixth interspace; a second, post-median, larger than the first, attaining the suture but narrowly separated from the lateral margins, deeply and broadly indented anteriorly at the seventh interspace and posteriorly at the fifth and sixth interspaces; the third subapical, small, oval, separated from the lateral margin and suture as the first; remaining surface of elytra with pale pubescence. Underparts of thorax and hind coxæ dark. Abdomen pale, all finely and densely punctured, sparsely pubescent. Legs long, femora with apices and an internal marking dark; tibiæ with more than the middle third dark, tarsi pale. Length, 7.5 to 11 millimeters.

*Male*.—Fifth abdominal sternite emarginate to a greater or lesser degree, sixth sternite and terminal dorsal rounded.

*Female*.—Fifth sternite broadly rounded, the rounded portion slightly in advance of the rest of the posterior margin; sixth sternite rounded, terminal dorsal subtruncate.

"East Mindanao, Philippines." Specimens before me are from the following localities in Mindanao: Zamboanga (Baker 4275), Davao (Baker 4276, 11905), Butuan (Baker 17585), and Surigao. There are also two specimens from Luzon, Laguna Province, Los Baños (Baker 574) and Mount Maquiling (Baker 4277).

Attention is here called to the variability of the secondary sexual modification of the male abdomen in species of *Omadius*. In certain genera, as for instance *Callimerus*, the specimens from a given locality do not vary perceptibly. In *Omadius*, on the other hand, hardly two males from the same identical locality will be alike so far as the depth and breadth of the emargination of the fifth abdominal sternite are concerned. In other respects the specimens do not apparently differ. It was my good fortune recently to examine a series of *Omadius indicus* Cast., of which eleven specimens were males, all collected at the same place. It was possible to select five specimens from the lot that differed sufficiently in the conformation of the abdomen to allow of differentiation by word description. This variability applies equally to the fourth sternite. There is no doubt in my mind that *Omadius fallax* Kuw. and *O. similis* Kuw. are both synonyms of *O. fasciipes* Westw. as I have been able to separate the three "species" out of a series of individuals from Borneo. Kuwert's species are both based on variations in the abdominal sternites. It may also be that *O. notatus* Gorh., described above, will fall as a synonym of Westwood's species. For the present they are considered distinct, though very closely allied.

#### *Omadius nimbifer* Gorham.

*Omadius nimbifer* GORHAM, Cist. Ent. 2 (1876) (1875-1882) 102.

Form of *O. notatus* Gorh. but larger in size. Head densely punctured, the punctures between and behind the eyes fine, those low down on the front coarse and somewhat confused; interocular carina low down, broad and short; color pale except for the piceous epistoma; antennae as in the generic diagnosis, pale, the third to fifth segments darker. Pronotum longer than broad, sides nearly straight, widest toward the front, anterior and basal transverse impressions distinct, portion anterior to the anterior

impression coarsely reticulate, remainder finely and densely punctured, rather densely clothed with pale depressed hairs. Elytra punctured as in *O. notatus*. Maculations much as in that species but differing as follows: The first is not crossed by a line of pubescence in the sixth interspace but is invaded on the posterior margin by a long finger of pubescence in the fifth interspace; the spot also attains both the lateral and the sutural margins. The second attains the lateral margin broadly, is hardly indented anteriorly but is indented posteriorly along the fourth and fifth interspaces. The third spot is similar in the two species. The elytra are pale at the extreme base but otherwise are very dark piceous, relieved by the patches of pale pubescence. Underparts finely and densely punctured, pale reddish yellow except for the lateral portions of the mesothorax and the posterior coxae. Anterior and middle femora pale with a small external dark spot at apical third; posterior femora and all tibiae annulate; tarsi pale. Length, 11 to 14 millimeters.

*Sexual characters.*—The description under *O. notatus* Gorh. will apply to this species equally well, except that the terminal dorsal segment of the male is more truncate than rounded.

"East Mindanao and Luzon." The material before me is all from various localities on Mindanao; Butuan (Baker 4270, 17588), Zamboanga (Baker 7291), Dapitan (Baker 11874), Iligan (Baker 12740, 12741), and Kolambungan (Baker 13520).

*Omadius kamelianus* White.

*Omadius kamelianus* WHITE, Cat. Cler. Brit. Mus. (1849) 53.

Form similar to that of the preceding species but smaller. Head very minutely punctured, occiput finely and indefinitely rugulose, front below eyes more coarsely and distinctly punctured, interocular carina as in *O. nimbifer*. Color pale, front densely clothed with long pale hairs. Pronotum longer than broad; anterior and basal transverse impressions distinct; disk finely and sparsely punctured, portion anterior to anterior impression feebly reticulate; pubescence sparse, depressed, pale; color pale olive green, underparts dark. Elytra with puncture rows extending to beyond postmedian dark spot, surface between punctures finely punctulate. Maculations as described in key; the postmedian is transversely reniform in shape, touching the suture but not crossing the tenth interspace, emargination on posterior border occurring at the fifth interspace and including part of the fourth and sixth. General color paler than in either the preceding or following species. Mesosternum dark, rest of underparts pale. Anterior and middle legs pale except for a very small spot on

the external face of each femur, posterior femora annulate at apical third and at apices, posterior tibiae with indistinct annuli at middle. Length, 10 millimeters.

*Male*.—Unknown.

*Female*.—Characters similar to those of *O. notatus* Gorh.

"Philippine Islands." Material before me from Mount Bana-hao, Luzon (Baker 581).

I should merge *O. kamelianus* White, *O. nimbifer* Gorh., and *O. sibuyanus* sp. nov. into one under the first name were it not for the fact that the material from each of the three islands appears to be constant and different. The differences are unfortunately in the facies rather than in any definite describable character.

**Omadius sibuyanus** sp. nov.

Length of *O. kamelianus* White but more robust. Head distinctly transversely rugulose on occiput, front finely and densely punctured, interocular carina almost obsolete, situated low down on the front on a small dark spot. Color pale, except for the above-mentioned spot and the epistoma. Pronotum dark olive green, with anterior and basal transverse impressions distinct, anterior portion more coarsely reticulate than in *O. kamelianus*, disk finely, sides more coarsely and densely punctured, pubescence pale and depressed, moderately dense. Elytra dark olive with black spots; postmedian spot on each elytron strongly undulate, reaching suture but very narrowly separated from lateral margin, twice indented on anterior margin (on the second and third, and on the seventh and eighth interspaces), thrice indented on the posterior margin (on the first or sutural, on the fifth and sixth, and on the ninth interspaces). The humeral callus is also dark piceous. Pro- and mesosterna piceous, lateral portions of metasternum dark, rest of underside reddish yellow. Anterior and middle femora annulate with dark just before apices, apices themselves dark, posterior femora dark at bases and apices and with dark annuli; all tibiae broadly annulate; tarsi pale. Length, 10 millimeters.

*Male*.—Unknown.

*Female*.—Characters as in *O. notatus* Gorh.

Type, a female from Sibuyan (Baker 18585); paratype, same data (Baker 18586).

Closely related to the two preceding species but, I believe, distinct. The two specimens before me are identical and are quite different in appearance from any of the long series of *O. nimbifer* Gorh. that I have studied.

*Omadius posticalis* Gorham.

*Omadius posticalis* GORHAM, Cist. Ent. 2 (1876) (1875-1882) 105.

As this species is unknown to me, I quote Gorham's original description in its entirety.

Brevior, niger, prothorace transversim subtiliter rugoso, elytris piceis cinereo pubescensibus, basi seriatim punctatis, striis fere integris, fasciâ latâ pone medium nigrâ, pedibus nigris, tibiarum atque femorum basi, tarsisque testaceis, pectore et abdome rufis. Long. lin. 4½.

A little like *O. femoralis*, but the fascia is placed further behind, the antennae are much shorter, the two basal joints pale, but the short club entirely black, the thorax transversely wrinkled especially in front, and shorter than in *femoralis*, legs nearly black, only the base of thighs and tibiae and underside of anterior thighs pale, breast red, etc.

Habitat: Philippines, (Semper).

From the above, it appears that the species is nearest to *O. notatus* Gorham of any of the known Philippine forms. At any rate, it is if the characters selected for the key are of fundamental value, as I believe they are.

**Genus OPERCULIPHORUS Kuwert**

*Operculiphorus* KUWERT, Ann. Soc. Ent. Belg. 33 (1894) 399 and 410;  
SCHENKLING, Gen. Ins. (Wytsman) Cleridae (1903) 76.

*Generic characters.*—Clerinæ; form elongate, slightly wider at middle of elytra, *Omadius*-like. Eyes finely granulate, moderately and acutely emarginate, labrum emarginate; antennæ eleven-segmented, first segment stout, slightly bent, second small, globular, third to tenth thin and long, equal in width and subequal in length, each with a few long hairs, eleventh longer than tenth, acuminate; terminal segment of maxillary palp cylindro-acuminate, that of labial palp broadly dilated toward the obliquely truncated apex. Thorax transverse, slightly constricted at base, anterior transverse impression moderate, anterior coxal cavities open behind. Elytra slightly dilated toward the middle of their length, the apices together rather abruptly rounded, punctate-striate, the punctures becoming obsolete just before the apex. Abdomen with six visible sternites, legs rather long, femora swollen, tarsi with the second segment overlying the first, the claws with small basal tooth. Males sometimes with very large terminal abdominal tergite.

Genotype, *Operculiphorus tubifer* Kuwert.

Geographical range, Malayan Region.

This genus was originally erected to care for a species with a very accentuated male secondary sexual character. That char-

acter in itself would hardly be sufficient to sustain the genus; but, if the elongate form and the broadening of the elytra are taken into consideration, the genus may be retained. In a series of several as yet undescribed species from Borneo the males show a regular and gradual reduction in the size of the terminal tergite. For this reason I have assigned the following species to this genus, even though the external male sex characters are but feebly developed:

*Operculiphorus philippinus* sp. nov.

Form elongate, head and thorax short. Color piceous, the anterior and posterior margins of the thorax, the first and second segments of the antennæ, the palpi, and parts of the legs castaneous. Head sparsely punctured, especially between the eyes, the punctures on the vertex and occiput finer than those on the epistoma; pubescence sparse, pale, suberect. Thorax transverse, almost as wide at base as at apex, anterior transverse impression feeble, disk densely and moderately coarsely punctured; in front of the anterior transverse impression the punctures are replaced by transverse wrinkles, flanks smooth, very sparsely punctured; lateral dilations with circular fovea on each; pubescence denser on disk and on margins. Elytra with ten rows of punctures extending almost to apex, surface shining, clothed with both dark and pale depressed hairs and with a few spinelike bristles arising from intervals 3, 5, and 9; the dark depressed hairs are concentrated in three patches on each elytron, one subcircular at basal third near suture, a second slightly postmedian and directly behind the first, and a third, very irregular in shape, subapical, reaching from margin to suture. Underparts finely and sparsely punctured, surface between the punctures alutaceous. Legs moderately long, the basal half of the femora pale. Length, 3.5 to 5 millimeters.

*Male*.—Terminal abdominal tergite broadly rounded, slightly larger than the corresponding sternite, which is very feebly emarginate.

*Female*.—Unknown.

Type, a male from Basilan (*Baker*); paratype, a male from Dapitan, Zamboanga Province, Mindanao (*Baker*).

This species differs from the genotype, *O. tubifer* Kuw., in having the thorax less distinctly constricted at the base and in having the last abdominal tergite hardly larger than the sternite. While the genus is not very distinct from *Thaleroocnemis*, there is still a difference in facies which is worthy of recognition.

Genus **RHYTIDOCLERUS** Kuwert

*Rhytidoclerus* KUWERT, Ann. Soc. Ent. Belg. 38 (1894) 400 and 419;  
SCHENKLING, Gen. Ins. (Wytsman) Cleridae (1903) 78.

*Generic characters.*—Clerinæ; form robust, subdepressed. Head vertical, front between the eyes moderately narrow, eyes finely granulated, rather deeply emarginate, labrum bilobed; antennæ eleven-segmented, first segment stout, slightly bent, second short and globular, third slender and longer than any other segment, fourth to tenth thin and narrow, each widest at its middle and each with a few long hairs, eleventh longer than tenth, parallel, acute at apex. Terminal segment of maxillary palp stout, cylindro-acuminate, that of labial palp long, strongly widened toward apex, which is obliquely truncate. Thorax transverse, sides rounded, basal transverse impression deep and distinct, anterior transverse impression feeble, anterior coxal cavities narrowly open. Elytra broadest at base, acute at apex, punctate-striate, the punctures coarse and rasplike on the basal half, becoming obsolete behind the middle; surface with a few coarse spinelike bristles which do not arise from distinct tubercles. Abdomen with six visible ventral segments. Legs moderate, femora not particularly swollen; tarsi of five segments, the second overlying the first and longer than any of the others, claws with a basal tooth. In the male, some of the abdominal sternites may be modified, and the claws of the anterior pair of legs bear a much larger basal tooth than the others.

Genotype, *Stigmatium basipenne* Chevrolat.

Geographical distribution, Malayan and Australian Regions.

Up to this time there have been four species assigned to this genus. A fifth, described by Gorham as *Stigmatum subfuscum*, is now added.

**Rhytidoclerus subfuscus** (Gorham).

*Stigmatium subfuscum* GORHAM, Cist. Ent. 2 (1876) (1875-1882) 94.

Color above uniform piceous, abdomen and parts of legs reddish. Head finely punctured, more densely on epistoma and occiput, less densely between the eyes, pubescence sparse and yellowish, a tuft of snow-white hairs in the ocular emargination and antennal groove; antennæ piceous, the first and second segments pale reddish. Thorax finely and not densely punctured, rather thickly clothed with depressed yellowish pubescence. Elytra with rows of coarse punctures on basal half, the first seven rows complete, the eighth represented by a few punctures at the base and a few at about the middle, the ninth represented

by a few punctures at about the basal third, while the tenth is submarginal and is complete or virtually so. Basal half of elytra rather densely clothed with pale depressed pubescence, this becoming still denser at its posterior limit. There is then what appears under low power to be a nude transverse fascia but what is in reality a bar of very fine short black hairs. Beyond this is a more or less reniform spot of pale depressed hairs which joins the apical spot along the lateral margin. Underparts finely punctured, metasternum with two carinæ which run outward and backward from the intermesocoxal process; surface of abdominal sternites between the punctures alutaceous. Coxæ, trochanters, and basal half of each femur pale, the rest piceous. Length, 7 to 11.5 millimeters.

*Male*.—Sixth abdominal sternite broadly, shallowly but angularly emarginate.

*Female*.—All abdominal sternites simple.

"East Mindanao" (type). BASILAN (*Baker 11541, 11542, 11873*). MINDANAO, Zamboanga Province, Zamboanga (*Baker 4274, 6698, 7292*, and other specimens); Dapitan (*Baker 11892, 12744*, and other specimens); Lanao Province, Iligan (*Baker 13518, 13519*, and other specimens); Surigao Province, Surigao (*Baker*). LUZON, Laguna Province, Mount Maquiling (*Baker 7289, 11539*); Los Baños (*Baker 1153*); Mount Banahao (*Baker*).

In the original description of *subfuscum*, Gorham mentions that only the basal segment of the antennæ is pale. In the material described above, the basal and second segments are pale. This discrepancy can be accounted for by the rather small size of the second segment and by its very close approximation to the first. Gorham also states that the postmedian band is nude. Under the low power this condition appears to obtain, but with higher powers a rather dense pile of short black hair appears. In other respects the material before me satisfies in every particular the description of Gorham.

#### Genus *DASYCEROCLERUS* Kuwert

*Dasyleroclerus* KUWERT, Ann. Soc. Ent. Belg. **38** (1894) 399 and 410; SCHENKLING, Gen. Ins. (Wytsman) Cleridae (1903) 77; Col. Cat. (Junk) Cleridae (1910) 63.

*Generic characters*.—Clerinæ; head moderate, front between the eyes rather broad, eyes finely granulate and deeply triangularly emarginate, labrum bilobed; antennæ eleven-segmented, first segment large and stout, slightly bent, second short and

globular, third cylindrical, fourth to tenth of equal width and nearly equal length, eleventh oval, acuminate; terminal segment of maxillary palp cylindro-acuminate, that of labial palp dilated toward the obliquely truncated apex. Thorax longer than broad, sides feebly dilated, anterior coxal cavities open behind. Elytra parallel, covering the abdomen, punctures in rows. Abdomen with six visible sternites. Legs moderate, femora not especially swollen, tarsi with the second segment long, covering the first, claws with broad basal tooth.

Genotype, *Dasyoceroclerus viridis* Kuw.

Geographic range, Indo-Malayan Region, Australia, Africa.

The above characterization of the genus is drawn from a study of *D. cylindricus* (Westw.), a Bornean species. The only Philippine representative was recently described by Schenkling and, as it is unknown to me in nature, I give a free translation of his original description.

*Dasyoceroclerus banksi* Schenkling.

*Dasyoceroclerus banksi* SCHENKLING, Philip. Journ. Sci. § D 8 (1913) 304.

Yellow-brown, above with long black and white hairs intermingled, antennæ brown with the first two segments pale, elytra pale yellow with humeri, a spot on the basal margin, two post-median transverse fasciæ, each composed of longitudinal spots placed in a row, and sometimes a subsutural spot just behind the scutellum black or brown. Punctures of elytra in rows, becoming obsolete behind the middle. Underparts of the thorax blackish, abdomen brownish yellow. Legs whitish yellow, the tips of the femora, and tarsi dark, anterior and middle tibiæ annulate at the middle of their length with dark. Length, 6 to 7 millimeters.

Sexual characters not mentioned.

PALAWAN, Bacuit. Type No. 12364 in the collection of the Bureau of Science, Manila.

McGregor, in his discussion of the zoögeographical regions of the Philippines based on the avifauna, has noted that Palawan shows a much closer relationship to Borneo than to other islands of the main group. In this connection it is of interest to note that the present genus is represented in Borneo by six recorded species, but has not been detected on any of the eastern or northern islands of the Philippine group by Professor Baker. Greater collecting activity on Palawan and Balabac will un-

doubtedly uncover many other species of Cleridæ having pronounced Bornean affinities.

### Genus THALEROCNEMIS Lohde

*Thalerocnemis* LOHDE, Cat. Cler., Stett. Ent. Zeit. 61 (1900) 78;  
 SCHENKLING, Gen. Ins. (Wystsman) Cleridae (1903) 77.  
*Chlorocnemis* KUWERT, Ann. Soc. Ent. Belg. 38 (1894) 399 and 417.  
 (Preoccupied by *Chlorocnemis* Selys.)

*Generic characters.*—Clerinæ; form broad, depressed. Front moderately wide, eyes finely granulate, prominent, deeply and triangularly emarginate; labrum bilobed; antennæ eleven-segmented, filiform, first segment short and stout, second globular, about half as long as first, third to tenth elongate, each with from three to five long hairs, eleventh longer than tenth, acuminate; terminal segment of maxillary palp cylindro-acuminate, that of labial palp long, obliquely truncate. Thorax transverse, apical transverse impression feeble, basal impression distinct, sides dilated. Elytra gradually narrowed to tips, punctate-striate, intervals with a few coarse spinelike bristles which arise from simple punctures. Abdomen with six visible sternites, legs moderately long, femora swollen, tarsi with first segment short, concealed beneath the second, second long, claws long and slender with broad basal tooth.

In the males, the fifth and sixth segments may be modified and the claws of the anterior tarsi have much larger lobes than those of the middle or posterior tarsi.

Genotype, *Chlorocnemis tibiichloralis* Kuwert.

Geographic range, Malayan Region.

This genus, not previously reported from the Philippines, is closely related on the one hand to *Dasyoceroclerus* (of which it is made a subgenus by Schenkling) and on the other to *Phaeocyclotomus*. It appears to me to be as worthy of generic rank as is either of the other two mentioned. Two representatives of the genus are known to me from the region under discussion, one from Luzon, the other from Mindanao and Basilan.

#### Key to Philippine species of *Thalerocnemis* Lohde.

Intermesocoxal process of mesosternum spatulate, its lateral margins carinate, the carinæ running forward halfway across the mesosternum, metapleuræ dark.....	<i>T. variabilis</i> sp. nov.
Intermesocoxal process of mesosternum without carinæ, the lateral margins simply with bead which follows the margin of the coxal cavity, metapleuræ pale.....	<i>T. bakeri</i> sp. nov.

*Thalerocnemis variabilis* sp. nov.

Robust; color piceous, entire insect clothed with short, depressed, yellowish white hairs, thorax and elytra with a few spines. Head between the eyes with a few scattered punctures, in front and behind more densely punctured, occiput slightly wrinkled, pubescence on epistoma and frons longer than on other parts of the body. Thorax broader than long, rather densely punctured, the punctures varying in size in different individuals, pubescence moderately dense, mostly directed toward the median line. Elytra with ten rows of punctures reaching almost to apex, the intervals moderately convex with very many fine punctures and with a few heavy spinelike bristles, the latter especially on the first, third, fifth, and ninth rows. Surface entirely covered with yellowish white hairs. From the seventh interval to the margin these hairs are directed outward; inside the seventh interval the hairs occur in patches in which the direction of the individual hairs alternates. At the base, just before the middle, at apical third and at apex, the hairs are directed toward the suture. Underparts finely and densely punctured, the surface between punctures alutaceous, pubescence fine and dense, especially on the thoracic sclerites. Legs, especially the posterior femora, stout, pale, the knees, tarsi, and part of the tibiæ dark. The dark markings on the tibiæ form rings in the paler-colored specimens, while in the deeper-colored ones the entire tibiæ may be involved. Length, 5 to 7 millimeters.

*Male*.—Fifth abdominal sternite broadly and shallowly emarginate, sixth less broadly and proportionately more deeply emarginate.

*Female*.—Abdominal sternites simple.

Type, a male from Butuan, Agusan Province, Mindanao (*Baker* 4278). Paratypes of both sexes from Basilan (*Baker* 11871 and other specimens) and from the following localities on Mindanao: Dapitan (*Baker* 12746 and other specimens), Zamboanga (*Baker* 11544 and other specimens), Iligan (*Baker* 12743 and other specimens), Surigao (*Baker*), Kolambungan (*Baker*), and Tangkulan (*Baker*).

There appears to be no way by which the material listed above can be separated into two or more valid species. For any character chosen, the material is easily segregated into two or more species, but those specimens which group themselves according to one character find themselves distributed among two or three "species" if some other character is selected as a

specific criterion. Furthermore, geographic distribution seems in no way to govern the variation. The sexual modification of the male abdomen is variable, but there again it is impossible to draw distinct boundaries.

*Thaleroenemis bakeri* sp. nov.

Form more elongate than in the preceding species. Head between the eyes rather sparsely, below eyes very densely, and on the occiput moderately densely punctured, epistoma densely punctured at sides, smooth and shining in the middle; antennæ with the terminal segment twice as long as the tenth, terminal segment of labial palp more than three times as long as its greatest width. Thorax very finely and densely punctured, except for the narrow median line and the flanks which are almost impunctate; the lateral foveæ are much less distinct than in the preceding. Elytra with the usual ten rows of punctures reaching to about apical fifth and from there continued to the apex in the form of grooves; spinelike bristles on the third, fifth, and ninth intervals; arrangement of pubescence as in *T. variabilis*. Underparts densely punctured, surface between punctures alutaceous. Legs moderate in length, femora swollen, pale, the knees and tarsi dark. Length, 6.5 to 7.5 millimeters.

*Male*.—Emargination of the sixth abdominal sternite about as wide as deep, subtriangular.

*Female*.—Segments with margins simple.

Type, a male from Mount Maquiling, Laguna Province, Luzon (Baker 6083). Paratypes, both sexes, from the following localities on Luzon: Mount Maquiling (Baker 6080), Los Baños (Baker 572, 575, 1151), Mount Banahao (Baker).

It is remarkable that the color of the metapleuræ should be of specific value. In not one of all the specimens of *T. variabilis* is there the least tendency toward pale coloration, even though the abdominal sternites may be either dark or light. On the other hand, the Luzon species always has pale metapleuræ, even when the abdomen is entirely dark.

Genus PHAEOCYCLOTOMUS Kuwert

*Phaeocyclotomus* KUWERT, Ann. Soc. Ent. Belg. **38** (1894) 400 and 420; SCHENKLING, Gen. Ins. (Wytsman) Cleridae (1903) 79; Col. Cat. (Junk) Cleridae (1910) 66.

*Generic characters*.—Clerinæ; form depressed, tapering toward apex, head vertical, with eyes as wide as thorax, eyes

finely granulated, deeply emarginate, labrum deeply emarginate; antennæ eleven-segmented, first segment stout, somewhat bent, second short and broad, nearly spherical, third longer than first or any of the succeeding except the last, thin, fourth to tenth elongate-oval, flattened, each with a few erect bristlelike hairs, eleventh elongate-cultriform, not quite as long as ninth and tenth together. Terminal segment of maxillary palp short and thick, slightly tapering, truncate, that of labial palp elongate triangular, obliquely truncate. Thorax slightly broader than long, constricted at base, sides rounded, anterior coxal cavities open behind. Elytra acuminate at apex, with ten rows of coarse punctures on each, which become obsolete near middle. Abdomen with six visible sternites. Sexual modifications slight. Legs moderately long, tarsi five-segmented, basal segment short, situated beneath the elongate second, second to fourth with lameliform processes beneath, fifth as long as third, claws with a broad basal tooth.

Genotype, *Phaeocyclotomus verrucosus* Kuwert.

A large genus of widely distributed and poorly defined forms. About seventy species have been described, from the Malay Archipelago, Australia, and Africa. A revision based on structural characters is greatly needed.

From the Philippines I am able to recognize but two distinct species, distinguished one from the other by the following characters:

*Key to Philippine species of Phaeocyclotomus Kuwert.*

Elytra with rows of quadrate punctures; tarsi concolorous with the tibiæ.

*P. tapetum* (Gorham).

Elytra with rows of large clearly cut circular punctures; tarsi very dark or black.....

*P. nigripes* sp. nov.

*Phaeocyclotomus tapetum* (Gorham). Plate 2, fig. 12; Plate 3, fig. 23.

*Stigmatium tapetum* GORHAM, Cist. Ent. 2 (1876) (1875-1882) 95.

Form short and broad, strongly depressed. Head piceous, front below the eyes finely and densely punctured, with dense whitish pubescence, between the eyes and occipital regions sparsely punctured and rather sparsely pubescent; antennæ slightly paler than head, unicolorous, reaching to beyond the base of the pronotum. Pronotum piceous, broader than long, rather sparsely and finely punctured, moderately densely clothed with depressed whitish pubescence with a few erect dark hairs

intermingled; on the flanks there are numerous long white bristles; anterior transverse impression feeble, basal deep and distinct. Elytra piceous with a dark narrow transverse postmedian band, with rows of large quadrate punctures, the first seven of which extend to apical fourth, the last three are abbreviated and end at about the middle. The interspaces have a few stiff black spines irregularly arranged. Anterior to the dark transverse bar the pubescence is inconspicuous, short, depressed, and pale. Beyond the bar, for half the distance to the apex, the pubescence is very dense and white; apically it becomes somewhat sparser and is broken by a small subapical dark spot. Underparts of the thorax castaneous, of the abdomen reddish yellow. Femora pale yellowish white on basal half, dark apically, tibiæ and tarsi castaneous. Length, 6 to 8 millimeters.

*Male*.—Fifth and sixth abdominal sternites entire, transverse; terminal tergite rounded.

*Female*.—Fifth sternite and terminal tergite similar to male; sixth sternite rounded.

"Mindanao, Sarawak, Siam." Material before me as follows: MINDANAO, Davao Province, Davao (Baker 7287, 7288) : Zamboanga Province, Zamboanga (Baker 7290) : Lanao Province, Iligan (Baker 13521) : Surigao Province, Surigao (Baker). LUZON, Laguna Province, Mount Maquiling (Baker 6079, 6081). Specimens from Borneo do not appear to differ specifically from the Mindanao material.

**Phaeocyclotomus nigripes sp. nov.**

Form of *P. tapetum* (Gorham) but larger. Head similar to that of *tapetum* in color and sculpture. Pronotum more densely punctured, pubescence slightly denser, anterior transverse impression almost obsolete on disk. Elytra with rows of large circular punctures which become indistinct on the postmedian transverse dark fascia. Fascia about one-fifth of the elytral length in width (broader than in *tapetum*) situated just behind the middle; apical third of elytra covered with a dense vestiture of pale whitish pubescence which is broken by two small subapical dark spots on each elytron; basal half of elytra with mixed black and pale pubescence. Underparts of thorax piceous, of abdomen castaneous. Femora pale, apical half infuscate, tibiæ castaneous, tarsi black. Length, 11 millimeters.

*Male*.—Sixth abdominal sternite feebly emarginate. Otherwise as in *P. tapetum* (Gorham).

*Female.*—As in *P. tapetum* (Gorham).

Type, a male from Dapitan, Zamboanga Province, Mindanao (Baker 11875); paratypes, three females from the same locality.

I am unable to identify this species with any of those described by Kuwert. It appears to be quite local in distribution.

### Genus STIGMATIUM Gray

*Stigmatium* GRAY, Griffith's Anim. Kingd., Ins. 1 (1832) 375; LACORDAIRE, Gen. Col. 4 (1857) 464; KUWERT, Ann. Soc. Ent. Belg. 38 (1894) 398 (revision); SCHENKLING, Gen. Ins. (Wytsman) Cleridae (1903) 44; Col. Cat. (Junk) Cleridae (1910) 60.

*Generic characters.*—Clerinæ; form robust, tapering gradually to the acute apices of the elytra. Head erect, front moderately wide, labrum deeply emarginate, almost bilobed, eyes deeply emarginate, finely granulate, antennæ eleven-segmented, first segment stout, slightly bent; second globular, third to tenth somewhat triangular, each shorter and broader than its predecessor, eleventh longer than tenth, cultriform; terminal segment of maxillary palp cylindrical, slightly acuminate, that of labial palp long, wider at apex which is obliquely truncate. Thorax almost equilateral, sides broadly rounded behind the anterior transverse impression, constricted at base, anterior coxal cavities narrowly open behind. Elytra covering abdomen, acutely narrowed at apex, basal half with coarse rasplike punctures in rows, apical half sometimes with traces of striæ, finely punctured. Abdomen with six visible ventral segments, legs moderately long, tarsi with second segment longer than third, claws with basal tooth.

Genotype, *Stigmatium cicindeloides* Gray.

Geographical distribution, Indo-Malaysia, Australia, Africa.

The Philippine representatives of this extensive genus may be distinguished by the following characters:

#### *Key to Philippine species of Stigmatium Gray.*

1. Rows of punctures of elytra continued to apex.  
S. laterifoveatum Kuwert.  
Rows of punctures end at or just behind the middle..... 2.
2. Abdomen black, thorax finely transversely wrinkled.... S. bakeri sp. nov.  
Abdomen red or brownish red..... 3.
3. Frons carinate between eyes, antennal segments 5 to 10 three times as long as broad..... S. tuberculibase Kuwert.  
Frons not carinate between eyes, antennal segments 5 to 10 not more than twice as long as broad..... 4.

4. Anteapical pubescence forming an irregular ring inclosing a reniform spot of black, no trace of transverse bars of pubescence at apical fourth..... *S. sibuyanum* sp. nov.  
 Anteapical pubescence forming a solid spot except for minute nude points; at apical fourth there is a transverse bar of pubescence reaching from margin halfway across each elytron.  
*S. philippinarum* Gorham.

*Stigmatium philippinarum* Gorham.

*Stigmatium philippinarum* GORHAM, Cist. Ent. 2 (1876) (1875-1882)  
 93.

? *Stigmatium amboinæ* KUWERT, Ann. Soc. Ent. Belg. 38 (1894) 406  
 and 438; SCHENKLING, Col. Cat. (Junk) Cleridae (1910) 62.

Form robust, sides parallel to about middle of length of elytra whence they taper gradually to an acutely pointed apex. Color castaneous brown above, underparts and basal portion of femora pale brownish red. Head very finely and very sparsely punctured, with a few scattered hairs about the eyes. Thorax slightly longer than broad, sides somewhat dilated, anterior transverse impression rather feeble throughout, especially so on the disk, surface very finely punctured, highly polished. Scutellum conspicuously clothed with white hairs. Elytra with nine rows of coarse pitlike punctures on basal half, the ninth row (submarginal) being incomplete, the first five interspaces with a few setiferous pustules in each, the first interspace on each elytron wide and with the suture depressed below the surrounding surface to just beyond the end of the rows of punctures; the third and fourth puncture rows longer than any of the others; apical half of elytra very finely and rather densely punctured, with dark, depressed pubescence; basal half of each elytron, a marginal spot at apical fourth which extends halfway across the elytron toward the suture, and the apices are clothed with longer, whitish pubescence. Underparts very finely and densely punctured. Basal half of femora and tibiae pale, the rest of the legs dark. Pubescence of underparts white. Length, 10 to 15 millimeters.

*Male*.—Sixth sternite with a broad and very shallow emargination at tip.

*Female*.—Fifth sternite with a deep and narrow, almost rectangular emargination, sixth sternite rounded.

Luzon, Laguna Province, Mount Maquiling (Baker 12738); Mount Banahao (Baker 2407); Bataan Province, Mount Limay (Baker 2336). "North Luzon."

The type of this species was noted by Gorham as from Luzon.

*Stigmatium sibuyanum* sp. nov.

Form and size of *S. philippinarum* Gorham. Color deep piceous, metathorax, abdomen, and legs (except tarsi which are dark) castaneous. Head finely and rather sparsely punctured, tumulate between the eyes, sparsely clothed, especially about the eyes, with rather long white hairs. Thorax slightly broader than long, finely and closely punctured and finely alutaceous, sides and base with a few long whitish hairs, rest of surface with short black depressed pubescence. Sides moderately dilated, round, anterior transverse impression shallow but complete across disk, basal impression deep and distinct. Scutellum densely clothed with whitish hairs. Elytra with nine rows of rasplike punctures on basal half, the third row longer than any of the others, first five interspaces with setiferous pustules, sutural region depressed as in *S. philippinarum*, apical half of elytra very densely and minutely punctured. There is a median transverse band of yellowish white hairs which is irregular on the posterior margin, becoming wider between the third puncture row and the suture. In front of this band the surface covered by the rasplike punctures is sparsely set with similar yellowish white hairs. On about the apical fourth of each elytron there is an irregular ring of yellowish hairs inclosing a reniform black spot, the concavity of which is directed toward the apex of the elytron. The portion of this ring which connects the lateral margin with the suture is angulate at its middle, sending a triangular offshoot toward the base of the elytron. Underparts and legs finely, densely, and regularly punctured, sparsely clothed with short, depressed white hairs. Length, 10 to 15 millimeters.

*Male*.—Fifth sternite evenly and shallowly emarginate from side to side; sixth sternite almost truncate, feebly emarginate at apex.

*Female*.—Fifth sternite deeply triangularly emarginate, the emargination deeper than half the width of the segment; sixth sternite rounded.

Type, a female from Sibuyan (*Baker 18587*); paratype, a male from the same place.

Easily separated from either *S. philippinarum* Gorham or *S. bakeri* sp. nov. by the character of the thoracic sculpture and elytral pattern.

*Stigmatium bakeri* sp. nov. Plate 2, fig. 13.

Color deep castaneous brown, basal half of elytra lighter. Head finely and very densely punctured behind the eyes, less densely between them, epistomal region with a few coarse punctures at sides, conspicuous pubescence restricted to the margins of eyes and on clypeus. Thorax broader than long, especially so in male; sides much swollen behind the anterior transverse impression, which is almost obsolete across the disk; basal impression very deep and clearly defined; surface very finely transversely wrinkled with a few distinct punctures at the sides; pubescence of disk short and ferruginous, that of flanks longer and whitish. Scutellum densely clothed with whitish hairs. Elytra each with eight rows of pitlike punctures extending to about the middle of the length, the margin of each pit raised on the side toward the base of the elytron, rasplike; in the third and fifth interspaces, near the base, there are a few setigerous pustules; in the apical half, the punctures are very fine and dense; basal half almost entirely covered with depressed whitish pubescence; a small transversely oval spot at apical fourth, common to both elytra, a short, transverse, sometimes sinuate bar on lateral margin, also at apical fourth, and the apices also whitish pubescent; the rest of the elytra covered with a very fine, dark pile that is almost invisible. Underparts very dark with bluish reflections, sparsely clothed with white hairs. Femora with undersides blackish, upper sides pale brown, tibiæ pale brown, tarsi blackish. Length, 9.5 to 12.5 millimeters.

*Male*.—Pronotum very transverse; elytral humeri prominent; fifth and sixth sternites very broadly and shallowly emarginate; terminal tergite rounded.

*Female*.—Pronotum slightly broader than long; elytral humeri not conspicuously prominent; fifth sternite with a broad emargination which is of uniform depth across the median portion of sternite; terminal tergite and sternite simple, rounded.

Type, a male from Port Banga, Zamboanga Province, Mindanao. Paratypes of both sexes from various localities on Mindanao as follows: One female from Iligan (Baker 12739), one female from Zamboanga (Baker 7286), one female from Kolambungan (Baker 13517), twenty-one males and fifteen females from Port Banga, one male and one female from Mu-

mungan, five males and four females from Surigao, and seven males from Kolambugan. The type and specimens not credited to Professor Baker were received from Staudinger and Bang-Haas.

**Stigmatium encaustum Gorham.**

*Stigmatium encaustum* GORHAM, Cist. Ent. 2 (1876) (1875-1882) 93.

In the original description of this species, Gorham gives only two differential characters to separate it from *S. philippinarum* Gorh. These are (1) that the flattened portion of the elytra is even more distinctly depressed than in *philippinarum* and (2) that the species is conspicuously less pubescent than *philippinarum*. It is apparent that the first character to a certain extent depends upon the second, for the presence of pubescence tends to conceal depressions and elevations. There is before me a badly rubbed specimen of *philippinarum*, which fits the description of *encaustum* well; it is, however, from Luzon, while the type of *encaustum* was said to be from Bohol. As I have seen no material of this genus from Bohol, I am forced to allow the name to stand, though I believe that the two species are synonymous.

**Stigmatium tuberculibase Kuwert.**

*Stigmatium tuberculibase* KUWERT, Ann. Soc. Ent. Belg. 38 (1894) 442.

This species, originally described from Borneo, is reported from the Philippine Islands by Schultze.<sup>4</sup> For this reason it is included in the key though I have seen nothing resembling it from the Islands.

**Stigmatium laterifoveatum Kuwert.**

*Stigmatium laterifoveatum* KUWERT, Ann. Soc. Ent. Belg. 38 (1894) 440.

Schenkling<sup>5</sup> has reported this species from the Philippine Islands. Its type locality is Amboina, an island whose fauna is in general more closely allied to that of Celebes than to that of the Philippines.

<sup>4</sup> Philip. Journ. Sci. § D 11 (1916) 46.

<sup>5</sup> Col. Cat. (Junk) Cleridae (1910).

**Stigmatium mastersi** MacLeay.

*Stigmatium mastersi* MACLEAY, Trans. Ent. Soc. N. S. Wales 2 (1872) (1869-1873) 269.

It is inconceivable that this Queensland species should be found in the Philippines. It would best be removed from the list until further proof of its occurrence is offered.

**Genus COPTOCLERUS novum**

*Generic characters.*—Clerinæ of small size. Front broad, eyes not very prominent, finely granulate, with a V-shaped emargination, labrum deeply emarginate; antennæ short, eleven-segmented, first segment thick, slightly bent, second slightly longer than broad, globular, third to fourth or third to fifth cylindrical, each about twice as long as broad, sixth or seventh to tenth subtriangular, and equal in length, each broader than the one preceding, eleventh cultriform (from equal to to twice as long as the tenth); terminal segment of maxillary palp cylindrical, slightly acuminate, sometimes subulate, that of labial palp broadly dilated toward tip and obliquely truncate. Thorax depressed, usually distinctly transverse, constricted at base, anterior transverse impression shallow, anterior coxal cavities open behind, often with a pronounced lateral cariniform margin. Elytra long, covering the abdomen, rounded or somewhat pointed behind, punctate-striate in basal half, rows of punctures continued toward apex in form of shallow grooves. Abdomen with six visible sternites. Legs moderately long, femora not swollen, tarsi with first segment very short, second the longest of all, claws with rather broad basal tooth.

Genotype, *Coptoclerus sericeus* sp. nov.

Geographic range, probably over the Indo-Malayan Region.

This new genus is erected to include eleven species of rather small clerids which do not appear to fit into any heretofore described genus. They are among the smallest of the true Clerinæ known to me. Of the eleven, nine are from the Philippine Islands. As the arrangement of the pubescence upon the elytra seems to offer the best means of separation, the following key emphasizes that character.

It is of considerable interest to note that in many of the species included there is a pronounced, sharply defined lateral

carina, passing beneath the lateral dilation of the thorax and strictly homologous with the lateral margin of the Enopliinæ and Korynetinæ. There is at least a trace of the carina in all species, but it reaches its greatest development in *C. obliquus*. It has been apparent to me for some time that there is no clean-cut division of this family into two subfamilies, to say nothing of two families. Some recent writers have attempted the latter division, but with little success. Even a division into seven tribes or subfamilies as here attempted fails in a few instances such as the present, but is on the whole tolerable.

*Key to Philippine species of Coptoclerus g. nov.*

1. Pubescence on elytra in clear-cut lines or spots forming a definite pattern ..... 2.  
Pubescence on elytra in irregular patches of indefinite extent ..... 7.
2. Black; suture not conspicuously pubescent throughout its length.... 3.  
Piceous, castaneous, or pale brown, never coal black; suture throughout its length narrowly bordered with white pubescence..... 4.
3. Each elytron with a triangular spot of white silky pubescence toward the lateral margin just before the middle..... *C. binotatus* sp. nov.  
Each elytron with an undulating median crossbar, subapical transverse spot starting at the margin and reaching halfway to suture, and apices broadly covered with white pubescence.... *C. fasciatus* sp. nov.
4. Each elytron with an almost equilateral triangle of white pubescence on the basal half, one side of which lies along the suture and with the opposite angle in the sixth interval, also with a short posthumeral bar lying in the ninth interval, a subapical undulating transverse bar and the apical margin clothed with white pubescence.  
*C. triangularis* sp. nov.  
Pubescence not as above..... 5.
5. Puncture rows very short, hardly reaching beyond the basal fourth; elytra with the scutellar region, an antemedian transverse spot near the margin, a median transverse spot of similar size and shape across the suture, a subapical lunate crossbar with the convexity toward the base on each, and the apical margin of each sparsely clothed with short white hairs..... *C. intricatus* sp. nov.  
Puncture rows continued to beyond the basal half; pubescence not as above ..... 6.
6. Each elytron with short white pubescence as follows: The scutellar region, a narrow oblique bar reaching from the suture just behind the scutellum to the eighth interval at the middle of the length of the elytron; a second and much shorter bar crosses this near its outer extremity, is oblique in the opposite direction and reaches from the ninth to the third row of punctures; at the apical fourth a transverse rectangle across the suture which is connected with the lateral margins at its posterior corners and the apices except for a denuded C-shaped spot on each; emargination of eyes large.  
*C. obliquus* sp. nov.

Elytra with an X-shaped mark of white hairs across the suture in the basal half, the lower points of the design touching the apices of triangles whose bases are on the lateral margins, these also of white hairs; the apices are covered, except for a large "V" and two small spots on each, with white hairs; eyes with small emargination.

*C. albipectus* sp. nov.

7. Thorax distinctly wider across middle than at anterior margin, puncture rows extending to beyond the middle of the length of the elytra, apical third and an irregular spot on outer half of width just before the middle more conspicuously pubescent than the rest.

*C. apicalis* sp. nov.

Thorax with sides straight, anterior transverse impression feeble, width of thorax across middle not greater than across anterior margin.... 8.

8. Puncture rows on elytra extending to beyond middle of length; elytra light brown, each with a piceous spot inclosing the humeral callosity and extending to about basal half and with five small irregular piceous spots on apical half, the light brown areas more densely pubescent than the dark..... *C. variegatus* sp. nov.

Puncture rows not reaching the middle of the length, except toward the lateral margins; elytra entirely piceous or nearly so; pubescence rather evenly distributed over entire surface but with the hairs directed partly toward and partly away from the suture... *C. sericeus* sp. nov.

*Coptoclerus binotatus* sp. nov.

Form elongate, parallel, depressed. Color black, antennæ piceous with the first and eleventh segments paler, palpi pale. Head finely and sparsely punctured, sparsely clothed with moderately long white hairs. Thorax slightly longer than broad (25-20), surface regularly covered with small granulations, from each of which a hair arises; the anterior transverse impression fails completely across the disk and is very feeble at the sides; along the flanks there are a few long and very stout spines, those nearest the base white; a few subdepressed white hairs on the disk near the basal margin. Elytra long, parallel, suture closed, covering the abdomen completely, with rows of large coarse punctures reaching beyond the middle, the intervals densely punctulate; just before the middle of the length and toward the lateral margin there is a triangular spot of white silky hair, one point of which is on the lateral margin, the other two in and toward the base; except for an ante-apical transverse bar, the upper surface is covered with short gray pubescence. Underparts shining, finely and sparsely punctured, flanks of metathorax clothed with silky hair. Legs black, finely punctured, somewhat rough, tarsi slightly paler. Length, 4 to 6 millimeters.

Type, a male from Mumungan, Lanao Province, Mindanao. Paratypes: Eighty-three specimens, males and females, from Mumungan; one male from Surigao, Surigao Province (Baker); and one male from Davao, Davao Province (Baker 7280). The specimens from Mumungan were received from Staudinger and Bang-Haas.

*Coptoclerus fasciatus* sp. nov.

Form elongate, parallel, depressed. Head very finely and sparsely punctured, shining, front wide, eyes with rather small emargination. Antennæ with terminal segment almost as long as ninth and tenth together. Thorax slightly longer than broad, polished, very finely and sparsely granulate, anterior transverse impression rather deep, sparsely clothed with fine depressed white hairs, flanks with a few bristles. Elytra with rows of punctures extending to apical fourth, the first three rows shorter than the fourth or fifth, surface between punctures granulate, with short depressed hairs both black and white. White pubescence as described in key; however, occasionally the apical pubescence merges with that of the subapical transverse spot. The two may be distinguished because the hairs are much less dense on the apices than on the spots. Underparts alutaceous, finely and sparsely punctured, sparsely pubescent. Femora sparsely punctured, tibiæ rough, tarsi rather long. Length, 4 to 6 millimeters.

*Male*.—Terminal tergite enormously developed, resembling that of *Operculiphorus tubifer* Kuwert.

*Female*.—No apparent modifications of the abdominal sclerites.

Type, a male from Kolambungan, Lanao Province, Mindanao. Paratypes: Four specimens from Kolambungan (one of which is Baker 13514); four specimens from Port Banga, Zamboanga Province, two from Tangkulon, Bukidnon Province (Baker 14662); one from Dapitan, Zamboanga Province; and four from Basilan. Type and ten paratypes received from Staudinger and Bang-Haas.

It might be mentioned here that *Stigmatium* ? *iodinum* Gorham is apparently closely related to this section of the genus and should be transferred to *Coptoclerus*.

*Coptoclerus triangularis* sp. nov.

Form parallel, depressed, about three times as long as wide. Color piceous, flanks of thorax darker, palpi, legs (except for the apices of the femora and the tibiæ which are dark) pale.

Front wide, head shining, finely and sparsely punctured, set with a few depressed white and erect black hairs; antennæ with terminal segment as broad as long, almost circular. Thorax equilateral or nearly so, anterior transverse impression feeble, disk smooth and shining with a few fine punctures, lateral portions much more densely punctured and rather thickly clothed with suberect pale hairs; lateral margins with a few pale bristles. Elytra with rows of coarse punctures extending beyond middle of length, surface between the coarse punctures densely punctulate, clothed with fine black hairs evenly distributed over entire surface and with a pattern of white hairs as described in key; also a few pale bristles scattered over the surface. Underparts alutaceous, moderately densely punctured; first and most of second sternite pale. Legs finely punctured. Length, 3.7 millimeters.

Type, a specimen, apparently a female, from Baguio, Benguet Subprovince, Luzon (Baker 6078).

The fifth sternite is very broadly and shallowly emarginate; the sixth is rounded, as wide as the terminal dorsal segment. Purely from analogy, I assume it to be a female. There is no trace of the internal genitalia.

*Coptoclerus intricatus* sp. nov.

Form depressed, cylindrical, the elytra subacute at their apices. Color deep piceous, the terminal segment of labial palpi, coxæ, trochanters, and basal two-thirds of femora pale. Head shining, front wide, finely and sparsely punctulate except for two circular areas rather low down which are densely and rather more coarsely punctured, antennæ with the tenth and eleventh segments hardly separable, together forming an oval disk, terminal segment of labial palp shorter and broader than in the genotype. Thorax transverse, finely and sparsely punctured, sparsely pubescent with short suberect white hairs. Elytra with rows of punctures becoming obsolete at about basal third; beyond this there is scarcely a trace of striæ, the surface covered with very minute granules; from the center of each arises a short black hair; white pubescence as described in key. Underparts black, shining, the abdominal sternites very finely transversely strigose and sparsely punctured. Legs finely punctured, color as described above, tarsi rather short, the second segment but little longer than the third. Length, 3.2 millimeters.

Type, a specimen, sex uncertain, from Sibuyan (*Baker 18584*).

There appears to be a total absence of sexual modification of the abdominal sternites.

*Coptoclerus obliquus* sp. nov.

Form rather robust, parallel. Size large for the genus. Color pale brown, thorax and elytra variegated with piceous, legs with the basal half of the femora yellow, the rest darker. Head with front broad, polished, finely and sparsely punctured, the region in front of the line connecting the ocular emarginations and a small round spot just above each eye densely clothed with white silky hairs, antennæ dark except for the basal segment and the apical half of the eleventh, which are pale. Thorax slightly broader than long, finely and rather densely punctured, the apical margin very slightly roughened, lateral cariniform margin distinct, the flanks low down impunctate and highly polished; flanks, two large longitudinal discal spots, and a small roundish spot on each side of the disk piceous; pubescence pale and depressed, with a few erect bristles scattered over the surface. Elytra with rows of coarse punctures reaching to about apical fourth, surface between punctures and at apex minutely granulate, a short black or brown hair arising from each granule; white pubescence as described in key. Underparts alutaceous, finely and rather sparsely punctured. Legs finely punctured. Length, 5.3 millimeters.

*Male*.—Terminal abdominal tergite large, embracing the small terminal sternite, its edges rolled down and furnished with a small sharp chitinous thorn on either side.

*Female*.—Abdominal segments unmodified.

Type, a male from northern Luzon, sent me by Dr. K. Jordan of the Tring Museum; paratype, a female from Los Baños, Laguna Province, Luzon (*Baker 573*).

*Coptoclerus albipictus* sp. nov.

From robust, hardly depressed. Color piceous, legs, especially the basal halves of the femora and tarsi, pale. Head with front wide, finely and sparsely granulate, sparsely clothed with depressed white hairs, eyes rather minutely emarginate, almost as in the Hydnocerinae; terminal segment of maxillary palp elongate-conical. Thorax with the anterior transverse impression feeble, sides nearly parallel, surface sparsely and finely granulate, sparsely clothed with depressed white hairs. Elytra with rows of large punctures extending to about apical fifth,

interspaces and apices densely and minutely granulate, densely clothed with short erect brown hairs; white pubescence as described in key. Underparts alutaceous, the mesopleuræ with a few very large pits in lieu of punctures, the rest finely and sparsely punctured. Legs finely punctured, hind tibiae without longitudinal carina. Tarsi rather long, claws slender with broad basal tooth. Length, 3 millimeters.

*Male*.—Fifth sternite broadly and shallowly emarginate.

*Female*.—Unknown.

Type, a male from Surigao, Surigao Province, Mindanao (Baker).

This species is the least depressed of all those that I have included in the genus. It has somewhat the form of the scolytid *Chramesus icoriae* or, to a less extent, that of a *Scolytus*. I have seen but one specimen.

*Coptoclerus apicalis* sp. nov.

Form parallel, depressed. Head minutely and sparsely punctured, punctures denser behind eyes; antennæ with the terminal segment as long as the ninth and tenth taken together; last segment of labial palp twice as long as breadth at widest part. Thorax transverse, widest just in front of the middle, anterior transverse impression distinct, surface sparsely set with fine granules, sparsely pubescent with depressed pale hairs; a few bristles scattered over the surface, especially on the flanks; anterior margin narrowly pale. Elytra with the rows of punctures reaching to apical third, surface between punctures very finely granulate, a short hair arising from each granule; bristles, similar to those on thorax, occur at frequent intervals; the pale pubescence on apical third directed outward, from suture toward lateral margin, that of the antemedian spot directed inward toward suture. Underparts alutaceous, finely and rather sparsely punctured. Legs finely punctured, anterior and middle femora pale with a dark blotch of indefinite extent on the upper side, posterior femora with basal half pale, rest of legs piceous; tarsal claws rather long and slender. Length, 4 millimeters.

*Male*.—Fifth abdominal sternite shallowly and broadly emarginate; sixth sternite rather small, rounded; terminal dorsal segment large, rounded, edge slightly thickened.

*Female*.—Unknown.

Type, a male from Dapitan, Zamboanga Province, Mindanao (Baker 12747).

In shape of thorax this species is more closely related to *C. fasciatus* than to *C. sericeus*, which it more closely resembles superficially.

*Coptoclerus variegatus* sp. nov.

Form depressed, sides parallel to apical fourth of elytra, thence gradually narrowed to the acute apex. Color pale brown, variegated with piceous. Head broad in front, finely, sparsely, and evenly punctured, sparsely clothed with suberect pale hairs; tenth and eleventh segments of antennæ closely united, eleventh longer than tenth, together forming an oval plate; palpi testaceous. Thorax distinctly transverse, sparsely covered with minute granules, a short depressed hair arising from each granule; median line distinctly less granulate than sides; anterior transverse impression feeble; pale brown, an elongate median spot just before the base and the flanks behind the anterior impression piceous. Elytra with rows of punctures running slightly beyond the middle, the first four intervals much (about twice) broader than the rest, fifth and sixth puncture rows the longest, reaching to apical fourth; apices with traces of striæ, surface between large punctures of rows and of apices very finely punctulate, piceous markings as described in key; light brown areas with depressed pale pubescence. Underparts alutaceous, sparsely and finely punctured. Legs testaceous, partly clouded with dark; tarsi rather short, claws with tooth broader and with apical portion more nearly at right angles to basal portion than usual. Length, 4 millimeters.

Type, a specimen, sex uncertain, from Dapitan, Zamboanga Province, Mindanao (*Baker*).

In this species the postscutellar region is distinctly depressed below the level of the humeri. The specimen before me has the hind margins of all abdominal sternites entire. It is, I believe, a female.

*Coptoclerus sericeus* sp. nov. Plate 2, fig. 14.

Form depressed, parallel, obtusely pointed behind. Head with front wide, very finely and sparsely punctured, sparsely clothed with pale depressed hairs, these more or less segregated in patches at the inside of the eyes, the center of the front, and the clypeal region; antennæ with the last five segments wider than the preceding, seventh to tenth nearly equal in size and shape, eleventh twice the length of tenth, narrowly cultriform. Thorax transverse, anterior transverse impression feeble, sur-

face shining, very finely and sparsely punctured, the punctures absent from a broad median longitudinal stripe; pubescence sparse and depressed. Elytra with rows of punctures reaching slightly postmedian, the fifth and sixth rows the longest, second interval wider than the first or third, third and fourth equal and each wider than any of the rest; the conspicuous pubescence on the elytra is arranged in a spot, subbasal and halfway between the suture and margin, a broad V, common to both elytra, the apex of which is on the suture slightly postmedian and the upper ends on the sixth row of punctures at about basal fourth. Behind this band is an undulating bar somewhat M-shaped, situated on the apical fourth. The remaining surface of the elytra is covered with fine, depressed dark hairs with a few scattered bristles, the fine hairs arising from very small granules. Underparts alutaceous, rather more densely punctured at sides than at middle. Legs pale, the knees slightly darker; tarsi pale, rather short and stout. Length, 4 millimeters.

*Male*.—Fifth abdominal sternite broadly and shallowly emarginate; sixth sternite and terminal dorsal rounded.

*Female*.—Sternites apparently unmodified.

Type, a male from Dapitan, Zamboanga Province, Mindanao; paratypes from Basilan and from Iligan and Surigao on Mindanao. All collected by Professor Baker.

#### Subfamilia THANEROCLERINÆ nova

*Subfamily characters*.—Cleridæ; head moderately large, epistoma not separated from frons by distinct suture, clypeo-frontal suture low down, labrum very small, emarginate; eyes convex and prominent, in the Philippine genera coarsely granulate, almost entire, antennæ eleven-segmented, intermediate segments moniliform. Thorax often with a poorly defined lateral cariniform margin, pronotum constricted at base, discal punctures oval, anterior coxal cavities narrowly open or closed externally. Elytra rounded behind, punctured irregularly or in distinct rows. Abdomen with the first sternite longer than the second, with sixth sternite very small, often concealed by fifth, first as long as second and third together. Legs short, femora usually stout, tarsi five-segmented, first four segments short, of the anterior tarsi very broadly dilated, fifth segment long, claws simple or with a poorly developed basal tooth.

The very broadly dilated anterior tarsi, the almost entire eyes, and the peculiar form of the cephalic and pronotal punctures serve to distinguish a small group of genera from the rest of the family. Of the genera which I assign to this subfamily, two

are found in the Philippines. These are *Thaneroclerus* Lef. and *Cyrtinoclerus* g. nov. A third is *Lyctosoma* Lewis, based on a single Japanese species; a fourth, *Neoclerus* Lewis, which was based on a Japanese species but now contains three other species from the Malayan Region. Both of these genera may be collected in the region under discussion. Two American genera, *Ababa* Csny. and *Zenodosus* Wolc., also belong here.

An additional reason for establishing the new subfamily is found in the structure of the larvæ. In their work on the larvæ of the North American Cleridæ, Böving and Champlain have shown that the larvæ of *Thaneroclerus* and of *Zenodosus* differ from all known clerid larvæ in possessing a well-developed though short epicranial suture.

*Key to the Philippine genera of Thaneroclerinæ.*

1. Elytra irregularly punctured, terminal segment of maxillary palp more than twice as long as broad; lateral cariniform margin of thorax distinct..... *Thaneroclerus* Lefebvre
2. Elytra with even and regular rows of elongate punctures; terminal segment of maxillary palp about as broad as long; lateral cariniform margin of thorax obsolete..... *Cyrtinoclerus* g. nov.

**Genus THANEROCLERUS Lefebvre**

*Thaneroclerus* LEFEBVRE, Bull. Soc. Ent. France 7 (1838) 13; SPINOLA, Rev. Zool. (1841) 73; Monog. Clérites 1 (1844) 205; KLUG, Clerii (1842) 309; LACORDAIRE, Gen. Col. 4 (1857) 449; SCHENKLING, Gen. Ins. (Wytsman) Cleridae (1903) 53; Col. Cat. (Junk) Cleridae (1910) 75; GAHAN, Ann. & Mag. Nat. Hist. VIII 5 (1910) 63.

*Isoclerus* LEWIS, Ann. & Mag. Nat. Hist. VI 10 (1892) 191.

*Thaneclerus* CHENU, Encycl. d'Hist. Nat. Col. 2 (1860) 247.

*Thanateroclerus* GEMMINGER and HAROLD, Cat. Col. 6 (1869) 1739.

*Generic characters.*—*Thaneroclerinæ*; head moderately large, eyes oval, convex, virtually entire, coarsely granulate; antennæ eleven-segmented, first segment stout and short, second to eighth subequal, short, moniliform, ninth and tenth subequal, wider than any of the preceding though but slightly longer, eleventh oval, as wide as tenth and almost as long as ninth and tenth together, the last three segments forming an oval club; terminal segment of maxillary palp cylindro-acuminate, that of labial palp broadly triangular with the apical margin rounded. Pronotum with distinct lateral cariniform margin, sides in front of middle parallel, posterior half rapidly narrowed to base, anterior coxal cavities very narrowly open behind. Elytra covering the abdomen, irregularly punctured, together rounded at apex. Abdomen with the sixth sternite very small, usually

concealed by fifth. Legs rather short, femora stout, claws simple.

Genotype, *Thaneroclerus buqueti* (Lefebvre).

Except for *T. girodi* Chevr. from the West Indies and southern United States and *T. dermestoides* Klug from Arabia, the species of this genus are Indo-Malayan. But one has been taken in the Philippines.

*Thaneroclerus buqueti* (Lefebvre).

*Clerus buquet* LEFEBVRE, Ann. Soc. Ent. France 4 (1835) 577, pl. 16, fig. 4.

*Thaneroclerus buqueti* WESTWOOD, Bull. Soc. Ent. France 8 (1838) 18; KLUG, Clerii (1842) 310; SPINOLA, Monog. Clérates 1 (1844) 207; GAHAN, Ann. & Mag. Nat. Hist. VIII 5 (1910) 63.

Form oblong, depressed. Entire insect except for eyes cas-  
taneous. Head rather large, front with elongate punctures,  
vertex and occiput with round punctures, finely alutaceous, eyes  
quite prominent, antennæ reaching almost to base of pronotum.  
Pronotum longer than wide with anterior transverse impres-  
sion entirely absent, basal impression deep and distinct, upper  
surface evenly, coarsely, and moderately densely punctured, the  
punctures oval, flanks below lateral cariniform margin sparsely  
punctured, alutaceous. Elytra irregularly, moderately densely  
and coarsely set with oval punctures, pubescence sparse and  
erect, sutural and lateral margins finely beaded. Underparts  
of thorax very coarsely punctured, abdomen rather finely so,  
metasternum deeply excavate in the middle of the posterior  
margin to receive the intercoxal process of the first abdomi-  
nal sternite. Legs short, femora rather finely, tibiae coarsely  
punctured. External sexual modifications apparently absent.  
Length, 5 millimeters.

"Bengal?" Los Baños, Laguna Province, Luzon (Baker 11869). Manila.

This is almost certainly the species of "Clerid" mentioned by Jones<sup>6</sup> in his work on the cigarette beetle in the Philippines. The habits described are nearly identical with those of the very closely related *Thaneroclerus girodi* Chevr. in the West Indies and Florida.

Genus CYRTINOCLERUS novum

Generic characters.—*Thaneroclerinæ*; head rather small, eyes oval, virtually entire, rather finely granulate; antennæ eleven-

<sup>6</sup> Philip. Journ. Sci. § D 8 (1913) 10.

segmented, first segment short and stout, second nearly as long as third, obconical, third to seventh subequal in length, eighth as wide as but shorter than seventh, ninth twice as wide as eighth and somewhat longer, tenth and eleventh mutually equal in width, wider than ninth, eleventh twice as long as tenth, round at tip; terminal segment of maxillary palp short and stout, equilateral, that of labial palp broadly triangular, truncate at tip. Prothorax longer than broad, widest anteriorly, strongly narrowed from anterior margin to base, anterior coxal cavities closed externally. Elytra covering the abdomen, with seriate punctures, the puncture rows near the suture somewhat confused. Abdomen with the sixth sternite very small, almost entirely concealed by the fifth. Legs short, femora swollen, tarsi with the fourth segment shorter than second or third, claws simple.

Genotype, *Cyrtinoclerus cyrtinoides* sp. nov.

Known only from Basilan. The resemblance which this genus bears to *Cyrtinus*, of the Cerambycidæ, has suggested the name. In the seriate punctuations of the elytra it differs from its nearest relatives, *Neoclerus* and *Ababa*.

*Cyrtinoclerus cyrtinoides* sp. nov. Plate 1, fig. 6.

Form oblong, cylindrical. Color dark piceous, almost black, except for the basal segments of the antennæ, the palpi, legs, and a transverse ill-defined marking in front of the middle of the elytra, which are paler. Head finely alutaceous, rather densely and coarsely punctured, the punctures elongate-oval; pubescence very sparse, silvery. Thorax longer than wide, in the form of a truncated cone, its greatest diameter at the anterior margin, basal diameter a little more than one-half of that, punctures deep and coarse, rather sparsely distributed, those on disk elongate, those on flanks polygonal, closely crowded together, pubescence fine, erect, sparse, silvery. Scutellum very small. Elytra with lateral margins parallel to apical third, thence evenly curved to suture at apex, with apparently twelve rows of punctures, the rows nearest the suture somewhat irregular. Elytra transversely depressed at basal fourth, the pale mark extends from the lateral margin across the elytron, just posterior to the depression, almost to the suture, where it curves anteriorly and completes a semicircle, ending at about the fifth row of punctures just behind the base of the elytron; basal sixth of suture also pale; the lighter portions of the elytra more or less densely clothed with short erect silvery hairs; there is

also a narrow anteapical bar of the silvery hairs, otherwise the pubescence is sparse, erect, and dark. Underparts, especially the metasternum, coarsely and sparsely punctured. First abdominal sternite as long as the next three together. Femora very stout. Length, 3 millimeters.

Type, a specimen, sex undetermined, from Basilan (*Baker*).

The depressed portion of the elytra with the covering of silvery hair gives this insect a somewhat myrmecoid appearance. In this respect it is quite different from the other members of this subfamily with which I am acquainted.

#### ENOPLIINÆ

*Subfamily characters.*—Cleridæ; eyes deeply and broadly emarginate anteriorly, antennæ ten- or eleven-segmented (in the Philippine genera), serrate or with the terminal segments elongate and forming a loose club. Thorax never greatly elongate, with distinct lateral cariniform margins; anterior coxal cavities open behind. Elytra almost or quite covering abdomen. Abdomen with six visible ventral segments; in some genera secondary sex characters occur on the abdominal segments. Legs rather short, tarsi with the fourth segment very small and included between the lobes of the third, first or basal segment as long as or longer than the second, claws with broad basal tooth.

At present, there are five genera belonging to this subfamily known to me from the Philippine Islands, two of which appear to be moderately rich in species. They can be distinguished one from another by the following characters:

##### *Key to the known Philippine genera of Enopliinæ.*

1. Form hemispherical, coccinelliform; pecten absent. *Allochotes* Westwood.
- Form elongate, cylindrical; pecten sometimes present..... 2.
2. Antennæ serrate, segments 4 to 11 subequal; pecten present..... 3.
- Antennæ with the terminal three segments greatly elongate, together greatly exceeding in length the rest of the segments combined; pecten absent..... 4.
3. Third antennal segment triangular, similar in shape to fourth; abdominal segments other than fifth and sixth of males carrying secondary sexual modifications..... *Teneroides* Gahan.
- Third antennal segment cylindrical, different in shape from fourth; abdominal segments (excepting fifth and sixth) without modifications in males..... *Tenerus* Castelnau.
4. Antennæ ten-segmented, tarsal claws simple, gular sclerite not reduced in size..... *Teneropsis* g. nov.
- Antennæ eleven-segmented, tarsal claws with a broad basal tooth, gular sclerite very small..... *Paratenerus* g. nov.

It has seemed best to create two new genera for two species which are both close to *Teneromimus* Gahan. With these, there are now four Malayan genera comprising six species, all of which are obviously closely related one to another and to *Tenerus*. The first of these, *Anisophyllus* Westw., is distinguished by having each of the intermediate antennal segments furnished with a conspicuous ramus. Through the extreme kindness of Prof. E. B. Poulton, who has given me certain information concerning Westwood's type, it is possible to rectify Gorham's error in transferring this genus to the Tillinæ and to restore it to the group in which it belongs and to which it was originally referred. However, it now becomes impossible to separate *Myopocera* Schklg. from it, and that genus must be suppressed. The second of the four genera, *Teneromimus* Gahan, is not as yet known from the Philippine Islands but may be found at some future time. It is represented by two species, *T. vitticollis* Gahan, its type, from Australia, and *T. humeralis* Gahan from the Solomon Islands. This genus is characterized as having ten-segmented antennæ, appendiculate tarsal claws, a reduced gular sclerite, and the lateral cariniform margin of the thorax feeble anteriorly. The above key to the genera recognized here emphasizes the differences between *Teneromimus* and the two new genera.

Though apparently of no great specific value, I would call attention to the tiny combs which occur at the apices of both anterior and middle tibiæ in the genera *Tenerus* and *Teneroides*. I have used the term pecten to designate these. In certain species, the number of denticles varies on the two sides of the same insect and for that reason I have not attempted to make use of that character.

#### Genus ALLOCHOTES Westwood

*Allochotes* WESTWOOD, Trans. Ent. Soc. London (1875) 241; SCHENKLING, Gen. Ins. (Wytsman) Cleridae (1903) 98; GAHAN, Ann. & Mag. Nat. Hist. VIII 5 (1910) 69. (Genotype: *bicolor* Westw., New Guinea.)

*Sisyrnophorus* WATERHOUSE, Ent. Mo. Mag. 13 (1876) 125. (Genotype: *maculatus* Waterh., Philippine Islands.)

*Generic characters.*—Enopliinæ; form hemispherical, subreticulate, closely resembling insects of the family Coccinellidæ; antennæ eleven-segmented, first segment stout and slightly bent, second short and globular, from the third on each segment is

slightly broader than the last, terminal segment about as long as ninth and tenth taken together; eyes rather flat, conspicuously and deeply emarginate at base of antennæ; terminal segments of both sets of palpi elongate-triangular. Thorax as seen from above with a semicircular outline, the sides and base forming an even curve from one anterior angle to the other, anterior coxal cavities very broadly open behind, prosternum remarkably short. Elytra with punctures evenly distributed over surface but not in definite rows, lateral margins explanate. Abdominal segments short and broad, fifth and sixth with slight secondary sex modifications. Legs short, femora not swollen in either sex, tarsi moderately long and stout, lobes large and prominent, claws with broad basal tooth.

Geographic distribution, Indo-Malaysia.

About sixteen species of this genus are known, three of which occur in the Philippine Islands. One of these is the monobasic type of *Sisyrnophorus* Waterh., which genus is at present not considered as distinct from *Allochotes* Westw.

The following key is based partly on word description (*maculatus* Waterhouse) and partly on material before me:

*Key to Philippine species of Allochotes Westwood.*

1. Elytra each with four circular spots; thorax with three spots.  
A. *maculatus* (Waterhouse).
- Elytra and thorax immaculate..... 2.
2. Last abdominal tergite of male rounded, fifth sternite emarginate, sixth sternite rounded..... A. *bakeri* sp. nov.  
Last abdominal tergite of male truncate, fifth and sixth sternites rounded.  
A. *pallidus* sp. nov.

*Allochotes maculatus* (Waterhouse).

*Sisyrnophorus maculatus* WATERHOUSE, Ent. Mo. Mag. 13 (1876)  
126.

Testaceo-ferrugineus, convexus, nitidus, pubescens; thorace maculis tribus, scutello, elytrisque maculis rotundatis octo, nigris. Long. 4 lin., lat. 3½ lin.

Head sub-rotundate, not very convex, with fine punctures not thickly scattered over the surface; eyes moderately large, but not prominent; antennae with the 5th joint scarcely as broad as long, the 6th to 10th joints very gradually a little shorter and stouter. Thorax distinctly broader than the head, very convex, finely and moderately thickly punctured, one fifth broader than long, very gently narrowed in front, entirely rounded behind, finely margined, the anterior angles a little less than right angles; a discoidal spot and a smaller spot on each side black. Elytra twice as broad as the thorax, about as long as broad, very convex and ample, broadest across the middle, gently rounded at the sides and apex; each

elytron arched and gently sinuous at the base, with four rather large round black spots, one humeral, one marginal, and two near the suture.

Head and thorax sub-retractile.

Hab.: Philippine Islands.

Brit. Mus.

As this species is unknown to me in nature, I have copied the original description. Nothing at all resembling the above description has been sent me.

*Allochotes bakeri* sp. nov. Plate 3, fig. 18.

Form ovate. Color testaceous except for the tips of the mandibles, which are black. Head pubescent, very finely and sparsely punctured; antennæ with segments 1 to 3 glabrous, 4 to 11 densely clothed with fine pubescence. Thorax much broader than the head, basal angles wanting, anterior angles slightly less than 90°, finely margined except on anterior edge where margin fails across the median portion; punctures very fine and sparse, becoming slightly denser toward the sides, pubescence moderately dense and long. Scutellum small, truncate behind. Elytra together nearly hemispherical, broadest just behind humeri, margin very fine and complete except along basal part of suture where it is wanting; punctuation moderately coarse and dense, evenly distributed. Underparts and legs finely and densely punctured. Length, 5 to 8 millimeters.

*Male*.—Fifth sternite slightly emarginate, sixth sternite rounded; terminal tergite truncate.

*Female*.—Unknown.

Type, a male, 8 millimeters, from Iligan, Lanao Province, Mindanao; paratype, a male, 5 millimeters, from Basilan. Both specimens collected by Baker.

Except for the great difference in size, I am unable to detect a single character that would serve to distinguish the specimens. On the other hand, there is no reason why the same species should not occur on both of these islands and, in fact, even in *Callimerus*, noted for its localized distribution, the same species occurs on both. It is probable that the two islands were connected with one another up to comparatively recent times.

*Allochotes pallidus* sp. nov.

Similar in appearance to the type of *A. bakeri* sp. nov. Differs in being more heavily punctured, especially on the abdominal segments, where the punctures are so close as to leave a dull surface, while in *A. bakeri* the corresponding portions of the insect are shining. The pubescence is conspicuously longer

in this species than in the last. Thorax is slightly less broad proportionally than in the last. Length, 8.7 millimeters.

*Male*.—Last abdominal tergite sharply truncate, fifth sternite slightly produced and broadly rounded, sixth sternite more sharply rounded.

*Female*.—Unknown.

Type, a male from Mount Maquiling, Laguna Province, Luzon (Baker).

Were it not for the quite different configuration of the ventral segments of the males, I should hesitate to describe both of the above species. The secondary sexual characters of the males, together with the distinct difference in the punctuation of the abdominal segments leave no doubt in my mind as to the propriety of separating the specimens under two names.

#### Genus TENERUS Castelnau

*Tenerus* CASTELNAU, Silbern. Rev. Ent. 4 (1836) 43; SPINOLA, Rev. Mag. Zool. (1841) 73; Monog. Clérètes 1 (1844) 161; LACORDAIRE, Gen. Col. 4 (1857) 475; GORHAM, Trans. Ent. Soc. London (1877) 402; SCHENKLING, Gen. Ins. (Wystsman) Cleridae (1903) 99; HINTZ, Deutsche Ent. Zeit. (1905) 312; SCHENKLING, Col. Cat. (Junk) Cleridae (1910) 117.

*Generic characters*.—Enopliinæ; head short and broad, labrum variable, terminal segment of maxillary palp slender, parallel, apex obliquely truncate, that of labial palp similar but smaller; antennæ eleven-segmented, first segment stout, bent, second nearly spherical, third twice as long as broad, rarely perceptibly dilated at apex, fourth to tenth subequal, triangular, as broad as long, eleventh twice as long as broad, diamond-shaped or oval. Thorax quadrate or nearly so, lateral cariniform margin distinct, sides subparallel. Anterior coxal cavities broadly open behind. Scutellum distinct, elytra long, parallel, never punctured in rows. Abdomen with six visible sternites, fifth and sixth sternites of male modified, fifth sternite of female with small notch, as in *Teneroides* Gahan. Legs short and stout, tarsi short, fourth segment very small, claws with a broad basal tooth.

*Genotype*, *Tenerus praeustus* Cast.

A genus of nearly ninety known species, three-quarters of which occur in the Indo-Australian region, the rest being African. To the four species previously known from the Philippine Islands I am able to add ten.

*Key to Philippine species of Tenerus Castelnau.*

1. Elytra at least in part blue or with bluish iridescence..... 2.  
Elytra not in any part blue..... 7.
2. Elytra entirely blue above the marginal bead..... 3.  
Elytra partly reddish above the marginal bead..... 6.
3. Size very large (18 millimeters), antennæ entirely pale, head mostly dark above..... *T. magnus* sp. nov.  
Size smaller (not over 9 millimeters), antennæ entirely or almost entirely black..... 4.
4. Head black, pronotum reddish with anterior margin and a small spot at the base black, abdomen reddish..... *T. cyanopterus* Spinola.  
Head and pronotum entirely reddish testaceous..... 5.
5. Antennæ and abdomen entirely dark, anterior angles of pronotum deeply and moderately densely punctate..... *T. luzonicus* sp. nov.  
Antennæ with first segment pale, abdomen concolorous with the thorax, anterior angles of pronotum rather sparsely and finely punctured..... *T. sibuyanus* sp. nov.
6. Elytra reddish with the apices broadly blue, antennæ black.  
*T. philippinarum* Chevrolat.  
Elytra bluish except for the extreme apices and anteapical spot near suture which are red, antennæ entirely pale yellow..... *T. pulcher* sp. nov.
7. Elytra entirely black..... 8.  
Elytra not entirely black..... 9.
8. Elytra each with a single pronounced costa near the suture, abdomen mostly pale, anterior margin of thorax broadly black.  
*T. mindanaonicus* Gorham.  
Elytra without costæ, abdomen black, anterior margin of thorax with three small black spots..... *T. trinotatus* sp. nov.
9. Elytra black, each with a rather broad longitudinal subsutural vitta of pale testaceous..... *T. vittiger* sp. nov.  
Elytra brown with black tips..... 10.
10. Elytra without a costa near the suture, head black, thorax entirely pale.  
*T. acostatus* sp. nov.  
Elytra with a very distinct costa near suture..... 11.
11. Pronotum with two round black spots on the anterior margin, costa not reaching to the middle of length of the elytron.  
*T. signaticollis* Castelnau.  
Pronotum not with two separate spots on the anterior margin, costa reaching to beyond the middle of length of the elytron..... 12.
12. Pronotum anteriorly black, head entirely black..... *T. nigripes* sp. nov.  
Pronotum and head entirely pale..... 13.
13. Abdomen and legs black, fifth abdominal sternite of female without notch at middle..... *T. obscurus* sp. nov.  
Abdomen and legs pale, fifth abdominal sternite of female notched at middle ..... *T. basilanicus* sp. nov.

The above key is purely artificial. Naturally, the species fall into three groups according to the following:

1. Elytra minutely tuberculate or granulate.....	Group A.
Elytra punctate.....	2.
2. Elytra each with a very distinct costa on the disk, anterior portion of pronotum granulate.....	Group B.
Elytra acostate, pronotum with simple punctures over the entire surface .....	Group C.

## GROUP A

*Tenerus trinotatus* sp. nov.

Form slender, parallel. Black, thorax and most of head and anterior and middle femora pale, pronotum with three black spots on anterior margin. Head with occipital dark spot rather small, very finely and sparsely punctured, sparsely pubescent. Thorax equilateral, slightly wider behind, basal margin discontinuous on either side of the disk, surface very finely and rather densely punctured, the punctures near the anterior margin replaced by granulation; the central spot triangular, the apex lying on the median line almost halfway to the basal margin, the lateral spots directly above the eyes, smaller and round. Scutellum pale, very slightly notched behind. Elytra with tips separately rounded, minutely and densely tuberculate instead of punctate, each tubercle giving rise to a hair. Costæ absent, suture and lateral margin beaded, bead continuous across base but absent across apex. Underparts finely punctured, sparsely pubescent. Length, 5 millimeters.

*Male*.—Unknown.

*Female*.—Fifth abdominal sternite with a deep, narrow slot.

Type, a female from Sibuyan, collected by Baker.

Distinguished immediately from all other known Philippine species by the granulations on the elytra in place of punctures.

## GROUP B

*Tenerus magnus* sp. nov. Plate 3, fig. 20.

Size large for the genus, form cylindrical, body about as deep as broad. Head dark piceous except for a pale interocular spot extending forward to labrum, rather coarsely and densely punctured, punctures slightly denser on vertex and upper part of frons; pubescence rather sparse, black; antennæ reaching about to base of pronotum, segments of serrate portion slightly broader than long. Pronotum almost equilateral, anterior transverse impression feeble but distinct, surface anterior to the impression minutely tuberculate, rest of surface sparsely but

rather coarsely punctured; basal marginal bead broken slightly on either side of the middle; pubescence sparse, erect, fulvous. Scutellum brownish. Elytra long, sides straight and parallel, each with a single costa on disk, which becomes obsolete at basal third, punctures slightly coarser than those of pronotum but much more densely placed, lateral marginal bead entire across apex, joining sutural bead, pubescence mixed black and gray, the black hairs longer, sparser, and more erect. Underparts very finely and rather sparsely punctured. Legs moderate, middle tibia of female with eight denticles in pecten. Length, 13 millimeters.

*Male*.—Unknown.

*Female*.—Fifth abdominal sternite with a broad shallow emargination, sixth sternite simple, rounded; terminal tergite similar.

Type, a female from Butuan, Agusan Province, Mindanao (Baker 17581).

The largest of the Philippine species before me. Separated from all of the related species by the entirely pale antennæ.

*Tenerus pulcher* sp. nov.

Form depressed, parallel. Color as described in key and below. Head finely and rather densely punctured, pubescence short and dense, vertex with a rectangular black spot reaching from between the eyes to the occiput, spot two-thirds as wide as long, a small black spot beneath and behind each eye, mandibles and palpi dark, rest of head and appendages pale yellowish. Pronotum with sides slightly curved, broader than long, anterior transverse impression well back toward the middle of the length, shallow and poorly defined, surface anterior to impression black and minutely tuberculate, that posterior to impression, with the exception of a small black spot on the flank, reddish yellow and finely and densely punctured; pubescence rather dense, colored as the surface whence it arises; marginal bead broken sharply on base near posterior angles. Scutellum black. Elytra long, parallel, very densely and rather minutely punctured, discal costæ absent, apices rounded, without bead, pubescence mostly golden, a small posthumeral spot and a subapical transverse bar being black; each elytron dark blue, with the extreme apex and extreme lateral margin from just behind the base to apical third, which is reddish yellow; a semicircular spot at apical fourth lying close to the sutural bead of the same color. Underparts pale, finely and densely punctured, densely pubescent.

Legs pale except for the tibial extremities of the anterior femora, anterior tibiæ, and all tarsi, which are black. Length, 6 to 7.5 millimeters.

*Male*.—Fifth abdominal sternite broadly and shallowly emarginate with an oval median depression; sixth sternite retracted, invisible in specimen; terminal tergite broadly rounded.

*Female*.—Fifth sternite with a narrow but very deep notch, the depth of the notch being almost one-half total length of segment; sixth sternite narrow, rounded at apex; terminal tergite feebly emarginate with a minute process in the center of the emargination.

Type, a male from Basilan; paratype, a female from the same locality; both specimens collected by Baker.

By far the most beautiful species of the genus known to me and closely allied to the next.

**Tenerus mindanaonicus Gorham.**

*Tenerus mindanaonicus* GORHAM, Trans. Ent. Soc. London (1877) 407.

Form cylindrical, rather stout. Reddish testaceous, head, anterior margin of thorax, elytra, tibiæ, tarsi, and last three abdominal sternites dark. Head rather coarsely and not densely punctured, pubescence sparse, front below the supraantennal ridges paler than vertex. Thorax about equilateral, anterior transverse impression distinct, surface anterior to impression minutely tuberculate, the rest rather coarsely and at the sides rather densely punctured, pubescence sparse. Lateral marginal bead carried across base of pronotum unbroken. Scutellum black. Elytra black, more densely and coarsely punctured than the pronotum, each with a single well-defined costa on disk, pubescence of black and gray hairs mixed, the black hairs sparse and erect, the gray denser and depressed. Marginal bead continued across the apex to join sutural bead. Underparts finely and moderately densely punctured, very sparsely pubescent. Legs short, tibiæ and tarsi densely pubescent; tarsal claws paler than rest of segment. Length, 7.5 to 8 millimeters.

*Male*.—Unknown.

*Female*.—Fifth abdominal sternite with a V-shaped notch, only slightly deeper than wide; sixth sternite small, acutely rounded at tip; terminal tergite similar to sixth sternite.

Described as from "Mindanao." Two specimens from Surigao, Mindanao, both females, have been received from Baker. One specimen bears the number 17583.

Superficially somewhat resembling *T. trinotatus*, from which it is easily distinguished by the punctulate elytra and the presence of costa. It is, however, much more closely related structurally to the preceding species and to *T. nigripes*.

*Tenerus nigripes* sp. nov.

Form and size of *T. mindanaonicus* Gorham. Head finely and sparsely punctured, supraantennal ridges broad and low, pubescence fine but rather sparse; antennæ reaching well beyond base of pronotum. Pronotum equilateral, anterior transverse impression broad but rather deep, portion anterior to impression minutely tuberculate or granulate, black except at flanks, rest of pronotum moderately coarsely but sparsely punctured and reddish yellow; marginal bead sharply broken on either side of base. Elytra very slightly wider posteriorly, each with a discal costa extending from the base nearly to the dark color at apex, punctures about the same size as those on pronotum, very densely placed, becoming finer and indistinct at apex; color testaceous, the apical fourth black; marginal bead complete across apex, meeting the sutural bead. Underparts very finely and very sparsely punctured, the punctures of the last three visible sternites more distinct and densely placed. Legs moderate, femora rather broad and shining, tibiæ closely punctured and thickly clothed with pubescence. Underside of thorax and first three sternites pale, rest black. Length, 6.5 millimeters.

*Male*.—Unknown.

*Female*.—Fifth abdominal sternite with a narrow V-shaped notch, twice as deep as width at widest part; sixth sternite and terminal tergite triangular, rounded at tips.

Type, a female from Basilan (Baker).

Closely related to *T. mindanaonicus*, but distinct in the formation of the fifth sternite of the female.

*Tenerus vittiger* sp. nov.

Form parallel, convex above, elongate. Color black, thorax (except for basal, apical, and lateral spots which are black) reddish testaceous, elytra each with a rather broad longitudinal subsutural vitta, inclosing a pronounced costa, yellowish testaceous. Head densely and finely punctured, sparsely pubescent. Thorax nearly square, basal margin double, angles blunt; anterior transverse impression broad and shallow, curved with the convexity directed posteriorly; the anterior black spot is

irregular in shape, entirely anterior to the anterior impression, the posterior spot is nearly circular with lateral projections along the basal margin; the lateral spots are very small and lie close to the lateral margin; surface finely and densely punctured. Elytra long, parallel, margins fine and complete, punctures very fine and very densely placed; pale vitta reaching to apical fourth. Underparts finely punctured, abdomen black except for the pale first sternite. Hind trochanters pale, rest of legs black. Length, 5.5 millimeters.

*Male*.—Third abdominal sternite with a small roughened spot on either side of the median line; fourth with short oblique carinae similarly placed, the carinae convergent posteriorly; fifth with similar but more developed carinae, in this case reaching the posterior margin of the sternite. The inclosed area on the fifth sternite is very rough.

*Female*.—Fifth abdominal sternite with a deep narrowed slot in the posterior margin.

Type, a male from Dapitan, Zamboanga Province, Mindanao; paratype, a female from Kolambungan, Lanao Province, Mindanao (Baker 13513).

*Tenerus obscurus* sp. nov.

Slenderer than *T. mindanaonicus* Gorham. Head finely and sparsely punctured, punctures near supraantennal ridges coarser and more closely placed. Color light piceous, antennæ black, reaching slightly beyond base of pronotum. Pronotum longer than broad, anterior transverse impression feeble and very indistinct, sides straight, parallel, marginal bead continuous across base, punctures on disk fine, on flanks coarser, moderately densely distributed, portion anterior to impression very finely and sparsely tuberculate, color reddish testaceous. Scutellum pale. Elytra each with a discal costa reaching from the base to about apical third, finely and rather densely punctured, the punctures becoming very fine at apices and almost indistinguishable, pubescence dense, fulvous; basal half pale reddish brown, apical half fuscous black, the line of demarcation between the colors indefinite. Metasternum and first abdominal sternite very sparsely punctured, other parts of thorax and abdomen densely punctured, the punctures fine on the thorax and coarser on the abdomen, pro- and mesosterna and all coxae pale, other parts dark piceous. Legs short and stout. Length, 5.5 millimeters.

*Male*.—Unknown.

*Female*.—Fifth sternite entire, without trace of the usual notch. The extreme tip of the abdomen is so retracted in the type and only specimen available as to make it impossible to state with assurance the exact contour. The sixth sternite appears to be entire and to have a longitudinal median carina extending from the apical margin toward the base.

Type, a female from Kolambungan, Lanao Province, Mindanao (Baker).

**Tenerus basilanicus sp. nov.**

Form moderately slender, parallel. Head entirely pale brownish yellow, finely and densely punctured, especially so near the supraantennal ridges; antennæ black, reaching well beyond the base of the pronotum. Pronotum pale brownish yellow, finely and densely punctured, sides straight and parallel, anterior transverse impression feeble, almost obsolete, anterior portion of pronotum minutely tuberculate. Pubescence of head and pronotum sparse, inconspicuous. Marginal bead broken at sides of base, very feebly developed across base. Scutellum pale. Elytra each with a discal costa reaching just beyond the middle, marginal bead continuous across apices, punctures rather fine and densely placed, toward the apices becoming much finer, almost obsolete; color brownish yellow, apical third of elytra black; pubescence sparse, suberect. Underparts brownish, the terminal segments of the abdomen slightly infuscate, first sternite sparsely, rest of abdomen densely punctured. Legs short, pecten of middle tibiæ with about four denticles, tarsi black. Length, 5.5 millimeters.

*Male*.—Unknown.

*Female*.—Fifth abdominal sternite with a very small median triangular notch; sixth sternite rounded, its apex slightly rolled outward; terminal tergite evenly rounded.

Type, a female from Basilan (Baker).

Nearest to *T. obscurus*, but easily separated from that species by the much closer punctuation of the head.

**Tenerus signaticollis Castelnau.**

*Tenerus signaticollis* CASTELNAU, Silberm. Rev. Ent. 4 (1836) 44.

This species was originally described from Java as follows:

Rouge, pubescent, finement ponctué. Corselet avec deux points noirs en avant. Elytres d'un brun jaune avec l'extrémité noire. Antennes, extrémité des cuisses jambes et tarses de cette dernière couleur.

In the case of the Philippine material, there is one point of difference that may prove constant in a series of specimens; namely, that the tibiæ are uniformly pale, only the tarsi being dark brown or black. The specific value of this character can only be demonstrated by the examination of series of specimens both from Java and from the Philippines. The material before me can be described as follows:

Form rather robust, parallel. Head entirely pale, rather coarsely and densely punctured, sparsely pubescent; antennæ entirely black, reaching slightly beyond the base of the pronotum, the intermediate segments acutely triangular. Pronotum with sides curved, slightly narrower anteriorly, anterior transverse impression feeble but apparent, portion anterior to impression minutely tuberculate, rest of surface coarsely punctured, the punctures much more densely placed on the flanks than on the disk; color brownish yellow, with two longitudinally oval spots, symmetrically placed, mainly on the tuberculate portion; marginal bead obsolete across base. Scutellum pale. Elytra each with a discal costa, rather feeble in the male, pronounced in the female, reaching from the base to about the middle of the length, marginal bead entire across the apices, meeting the sutural bead; punctures at base of elytra about as coarse as those of pronotum but much more densely placed; toward the apices the punctures become very fine; pubescence sparse, inconspicuous; color brownish yellow, the apical fifth of each elytron black. Underparts finely and sparsely punctured, sparsely pubescent. Legs moderate, pale, tarsi darker. Pecten of anterior and middle tibiæ with about four denticles in each. Length, 8 to 9.5 millimeters.

*Male*.—Fifth abdominal sternite with a broad, deep, semicircular depression inclosing a shallow emargination on the posterior margin of the sclerite; sixth sternite small, subtruncate; terminal tergite evenly rounded, its lateral margins tumid.

*Female*.—Fifth sternite with a V-shaped notch in posterior margin, the notch narrowing to its base; sixth sternite and terminal dorsal small, broadly and feebly emarginate.

Described from one male from Kolambungan, Lanao Province, Mindanao, and two females from Davao, Davao Province (*Baker 11555*) and Dapitan, Zamboanga Province, Mindanao (*Baker 12735*).

This species forms a sort of connecting link between the group of species designated in this paper as "B" and a group,

representatives of which I have from Borneo, in which the elytral costæ are absent but with the granulations present on the anterior portion of the pronotum.

## GROUP C

*Tenerus luzonicus* sp. nov.

Size small, form slender, cylindrical. Head convex, without spot on vertex, sparsely and finely punctured, pubescence sparse and erect; antennæ with the first four segments shining, the fourth slightly shorter than the third and a little wider but not more than half as wide as the fifth. Thorax slightly longer than wide, sides parallel, anterior transverse impression obsolete, entire surface of pronotum sparsely but rather coarsely punctured, the punctures denser on the flanks, pubescence sparse, suberect. Scutellum reddish. Elytra with sides straight and parallel, without trace of costæ on disk, punctures very variable in size, small and large intermingled, limits of each puncture poorly defined; marginal bead obsolete at the internal apical angle; pubescence cinereous, of mixed erect and depressed hairs. Underparts finely but rather sparsely punctured, pubescence sparse, thorax and appendages pale, abdomen black. Legs moderate in length, femora of female a little stouter than usual in the genus. Length, 4.5 millimeters.

*Male*.—Unknown.

*Female*.—Fifth abdominal sternite with triangular notch, as wide as deep; sixth with a longitudinal median depression on basal half; terminal dorsal very feebly emarginate.

Type, a female from Mount Limay, Bataan Province, Luzon (*Baker*).

The smallest species seen by me from the Philippines, although, as there are two species from Borneo which are smaller, it is by no means the smallest in the genus.

*Tenerus sibuyanus* sp. nov.

Form rather broad for the genus, parallel. Antennæ, except for first segment, and extreme tip of abdomen dark, elytra blue, rest of body reddish yellow. Head finely and sparsely punctured, sparsely pubescent, spot on vertex usually found in the genus absent; antennæ reaching to beyond base of pronotum. Pronotum rather evenly, finely, and sparsely punctured, the median longitudinal line smooth, without punctures, lateral marginal bead broken on either side of the middle of base and rather indistinct across base, width across anterior margin dis-

tinctly less than that across base, sides straight, greatest width about equal to length. Scutellum pale. Elytra very finely and densely punctured, at the apices the punctures are obsolete and the surface shining, discal costæ absent, marginal bead complete across apices, meeting the sutural bead, pubescence black, very fine and inconspicuous. Underparts finely and sparsely punctured. Legs rather slender, pecten of anterior tibia with four, of middle tibia with three denticles. Length, 8 to 10 millimeters.

*Male*.—Fifth abdominal sternite with a broad, shallow arcuate emargination; sixth sternite and terminal tergite rounded, entire.

*Female*.—Fifth sternite with a V-shaped notch which is deeper than wide; sixth sternite smooth and shining except at apex, with a median longitudinal groove reaching almost to the acutely pointed apex; terminal tergite strongly tapered, subtruncate at tip.

Type, a male from Sibuyan; paratypes, three females from the same locality; all specimens collected by Baker.

*Tenerus acostatus* sp. nov.

Form cylindrical, slightly tapering at the posterior extremity. Pale yellow-brown, except for the head, antennæ, tibiæ, tarsi, and the extreme tips of the elytra, which are black. Head distinctly but sparsely punctured, sparsely pubescent; the median vertical line between the eyes is slightly paler than the rest of the head; labrum entire; antennæ comparatively short, hardly exceeding the base of the thorax. Thorax equilateral, sides parallel; anterior marginal bead fine, entire; posterior marginal bead widely broken near posterior angles; anterior transverse impression absent; surface sparsely punctured, the discal and anterior punctures very fine, those near the posterior angles coarser, pubescence sparse. Elytra without costæ, finely margined, the marginal bead entire across the apices, punctures very densely placed, slightly coarser than the coarse punctures of the thorax, pubescence sparse and inconspicuous. First abdominal sternite very sparsely punctured, underparts of the thorax more densely punctured and rest of abdomen very densely punctured. Femora sparsely, tibiæ densely punctured, pubescence moderate. Length, 9 millimeters.

*Male*.—Unknown.

*Female*.—Fifth abdominal sternite with a small median, acutely triangular notch; sixth sternite with a longitudinal

median depression; terminal dorsal broadly and shallowly emarginate.

Type, a female from Sibuyan (*Baker 18979*).

As close to *T. praeustus* Castelnau as any Philippine species studied. Differs in the dark head, tibiæ, and tarsi, and in the unicolorous abdomen.

#### POSITION UNCERTAIN

##### *Tenerus philippinarum* Chevrolat.

*Tenerus philippinarum* CHEVROLAT, Memoire Clérates (1876) 37.

Reddish; pubescence fulvous, short and dense; coriaceous. Head round and convex, densely and finely punctured, antennæ and eyes black. Prothorax quadrate, convex, punctulate; anteriorly truncate, posteriorly somewhat arcuate with a narrow marginal groove; scutellum triangular. Elytra with the tips broadly blue. Body beneath, femora, and tibiæ red, the last two abdominal sternites and the underside of the tarsi darker. Length, 9 millimeters; width, 4.5.

Type locality, Philippine Islands.

The above is a translation of the original description. I have seen no insect that compares at all well with the description but believe that when the species is again collected it will be readily recognized. However, there is some doubt in my mind as to the correctness of the generic assignment. At the time and place of original description, Chevrolat notes that *Tenerus* Castelnau and *Stenocylidrus* Spinola appear to him to be synonymous. From that one is able to deduce a lack of knowledge on his part of one or the other or both of the genera. The dimensions given above indicate an insect half as wide as long, a condition which I consider improbable, if not impossible, in the genus *Tenerus*. Until the type is reexamined or until further material comes to light, the final disposition of the species is open.

##### *Tenerus cyanopterus* Spinola.

*Tenerus cyanopterus* SPINOLA, Monog. Clérates 1 (1844) 165, pl. 8, fig. 4.

As I have seen no material that can be identified as this species, the following description is derived from the original, cited above:

Form cylindrical, color reddish; head, a large transverse spot on the anterior margin, a smaller one on the posterior margin of the pronotum, the tibial extremities of the femora, the external portion of the tibiæ and the tarsi, black; antennæ black except for the first segment which is reddish. Punctuation of

the head sparse and indistinct, that of the elytra coarser and denser, slightly regular. Pubescence fine and sparse, cinereous. Length, 4 lines (about 8 millimeters).

Type, a specimen, sex not given, from Manille [Manila], Luzon.

On first glance, the species described in this paper under the name *T. luzonicus* was thought to be the same as that referred to above. The entirely dark abdomen of *luzonicus* shows, however, that full coloration has probably been obtained and that the absence of dark on the head and thorax is of specific value. It does not seem possible that either is the incompletely colored form of the other.

#### Genus TENEROIDES Gahan

*Teneroides* GAHAN, Ann. & Mag. Nat. Hist. VIII 5 (1910) 69.

This name was proposed by Gahan for a subgenus of *Tenerus* Cast., to include those species in which the antennæ are serrate from the third segment on. As this character appears always to be associated with others of equal or greater taxonomic value, the subgenus is here raised to generic rank.

*Generic characters.*—Enopliinæ; form elongate-cylindrical; antennæ eleven-segmented, segments from 3 on either broadly triangular or with short terminal rami; eyes finely granulate, deeply and broadly emarginate, terminal segment of maxillary palp elongate, cultriform, truncate at tip, terminal segment of labial palp similar in shape but smaller. Scutellum trapezoidal. Elytra long, suture closed the entire length, with or without well-developed costæ. Abdomen with six visible sternites, in the male the first, or second or third, or second and third, and fifth with conspicuous modification, the female with the fifth only modified but usually with the terminal tergite notched. Legs short and stout, hind trochanters of the males with spiniform or wedge-shaped process, hind femora of males swollen, tarsal claws with a broad basal tooth.

Genotype, *Teneroides tavoyanus* Gahan.

The four species of this genus that are known to me from the Philippines can be separated by the following key:

##### Key to Philippine species of *Teneroides* Gahan.

1. Elytra intensely black, thorax reddish yellow; process on first sternite of male very short and blunt, oval rather than triangular.  
T. melanopterus sp. nov. .... 2.
- Elytra not black.....

2. Upper surface yellow-brown, sutural margin of elytra and lateral margins of thorax sometimes infuscate..... 3.  
 Upper surface reddish vermillion, lateral margins of thorax blackish brown, female with a broad V-shaped notch on fifth sternite.  
*T. aurantiacus* sp. nov.

3. Thorax without a distinct tubercle before the scutellum, with a tubercle on either side of the gular sclerite..... *T. tuberculatus* sp. nov.  
 Thorax with a distinct tubercle before the scutellum, tubercles at sides of gular sclerite absent..... *T. bakeri* sp. nov.

*Teneroides melanopterus* sp. nov. Plate 2, fig. 16.

Form cylindrical, sides parallel, thorax narrowed in front and behind. Black; thorax, part of head, and the lateral margins of elytra narrowly reddish yellow. Head very finely and densely punctured, pubescence fine, short, and black, reddish yellow except for black spot between and above the eyes and the black clypeal region; antennæ more than twice as long as head and thorax together, entirely black, segments 3 to 10 broader than long, the eleventh elongate oval. Thorax punctured similarly to head, pubescence fine, short, and reddish; greatest width at basal third, basal marginal bead double, anterior margin with single, inconspicuous rim. Scutellum reddish; cordate. Elytra long, parallel, individually rounded at tips, sutural bead distinct to tips, without costæ, punctuation very fine and very close, with a few large punctures scattered over the surface, pubescence fine and dense with a few coarse erect hairs. Underparts and legs finely punctured, not densely pubescent. Length, 8 to 10 millimeters.

*Male*.—First abdominal sternite with small median triangular tooth; posterior trochanters broadly wedge-shaped internally; posterior femora greatly swollen; fifth and sixth sternites depressed medianly; terminal tergite truncate with very feebly developed median lobe.

*Female*.—Posterior femora and trochanters normal; fifth sternite with small median notch; sixth sternite and terminal tergite unmodified, rounded.

Type, a male from Sibuyan (*Baker 18980*); paratype, a female with the same data.

*Teneroides aurantiacus* sp. nov.

Form elongate, parallel. Color vermillion, lateral margins of thorax, antennæ, legs, and hind body black. Head very finely and densely punctured, sparsely pubescent, occiput clouded with fuscous. Thorax quadrate, slightly wider behind, finely mar-

gined, lateral margins entire, punctuation very fine and dense, hind angles wrinkled, pubescence fine and moderately dense. Elytra long, very slightly wider posteriorly, surface finely and not densely punctured, the punctures appearing black, surface between the punctures finely alutaceous; pubescence on basal half sparse, on apical half denser and arranged in four longitudinal stripes; elytra not costate. Underparts finely and sparsely punctured, black with a bluish reflection, punctuation of legs coarser; basal half of anterior femora pale. Length, 7 millimeters.

*Male*.—Unknown.

*Female*.—With the usual notches in the margins of the fifth sternite and terminal tergite.

Type, a female from Iligan, Lanao Province, Mindanao (Baker); paratype, a female from Basilan (Baker).

At first glance the Basilan specimen appears different, owing to its slightly deeper color. However, there appear to be no other differences.

**Teneroides tuberculatus sp. nov.**

Head finely and rather densely punctured, a smooth median line from level of top of eyes to occiput, pubescence fine, of short fulvous hairs with a few longer black hairs intermingled, occipital blotch reaching forward almost to level of ocular emargination; antennæ, region above mouth, and occipital blotch black. Thorax slightly wider than long, widest at basal third, finely and densely punctured, densely pubescent; toward the anterior angles there are four or five larger punctures, which may possibly carry sensory setæ, anterior angles dark. Elytra long, lateral margins slightly sinuous, sutural bead rather broader than in the next species, apices together rounded, punctures of two sizes, the larger rather sparsely, the smaller very densely placed, pubescence dense, fine, yellowish brown; four costæ very faintly suggested. Underparts black with faint bluish reflections, anterior coxæ and all trochanters pale, punctures very fine and dense, posterior smooth, margins of sternites broad, very finely alutaceous, pubescence black, mostly short hairs with a few longer ones intermingled. Length, 11 millimeters.

*Male*.—Unknown.

*Female*.—With the usual notch in the terminal tergite and in posterior margin of fifth sternite.

Type, a female from Butuan, Agusan Province, Mindanao (Baker 17582).

Easily distinguished from the next species by the total absence of stripes of pubescence on the elytra.

*Teneroides bakeri* sp. nov.

Form elongate, parallel. Color as described in key, female with sutural region dark, antennæ, occipital blotch, metasternum, abdomen, and legs blackish. Head very finely and not densely punctured, median smooth line broken on vertex, pubescence black, short and erect; terminal segments of all palpi dark. Thorax broader than long, broadest just before the base, surface densely and very finely punctured, pubescence dense and depressed, concolorous with the thorax. Elytra long, lateral margins slightly sinuate, very feebly costate, punctuation as in the preceding species, pubescence dense and depressed. There appear to be nine or ten longitudinal stripes of pubescence, the hairs of the alternate stripes commencing with the suture directed posteriorly; the hairs of the other rows point forward. Hence, when the insect is held with the head toward the observer, the effect is of alternate light and dark stripes. Underparts finely and densely punctured, densely pubescent. Length, 9 to 11 millimeters.

*Male*.—Antennal segments 4 to 10 each with a broad process as long as the body of the segment; first abdominal sternite with a median acutely triangular projection, about one-fifth as long as the sternite, arising just in front of the posterior border; fifth sternite depressed in middle, broadly and shallowly emarginate; sixth sternite with a deep, median longitudinal groove; margin of the terminal tergite strongly thickened; hind trochanters produced internally into a semicircular plate.

*Female*.—Fifth sternite with a V-shaped notch. Terminal tergite with small notch.

Type, a male from Sibuyan (Baker 18981); paratype, a female from the same locality (Baker 19338).

Genus **PARATENERUS** novum

*Generic characters*.—Enoplinae; head broad; labrum small, deeply emarginate, almost bilobed; eyes moderately finely granulated, deeply emarginated near insertion of antennæ; terminal segment of maxillary palp cylindrical, obliquely truncate at apex, that of labial palp cylindro-acuminate; antennæ eleven-segmented, first segment stout, two-thirds as thick as long, second globular, third to eighth short, closely fitted, forming a

mass about as long as the first and second segments together, ninth to eleventh very long, ninth and tenth each with ramus. Thorax quadrate or nearly so, lateral margin entire, anterior coxal cavities widely open behind. Elytra long, sides nearly parallel, almost covering abdomen, sometimes with faint costæ. Abdomen with six visible sternites, legs short and thick, claws with broad basal tooth.

Genotype, *Paratenerus mindanensis* sp. nov.

One species belonging to this interesting genus has been sent me by Professor Baker. The lateral margin of the thorax is complete and of even elevation throughout, and the antennæ are very distinctly eleven-segmented.

*Paratenerus mindanensis* sp. nov. Plate 3, fig. 21.

Form elongate-cylindrical. Color brown, covered with fulvous hairs, head and underparts darker. Head short, frons broad, finely and densely punctured; antennæ long, reaching to the middle of the length of the elytra, first eight segments together as long as ninth, tenth longer than ninth, eleventh the longest, more than twice the length of the ninth; ninth and tenth segments with short terminal rami. Thorax nearly quadrate, very finely and densely punctured, basal margin fine, distinct, pubescence fine and sparse, directed toward the median line. Scutellum moderate in size, round. Elytra long, not quite covering the abdomen, lateral margins sinuate just before the middle, surface finely roughened, individual punctures not distinct, densely covered with fulvous hairs. Underparts blackish, deeply and moderately densely punctured, lateral portions of abdominal sternites with small triangular smooth areas. Legs blackish, short, heavily punctured. Length, 5 millimeters.

Type, a specimen (sex uncertain) from Dapitan, Zamboanga Province, Mindanao (Baker).

The complete absence of secondary sexual modifications on any of the abdominal sternites suggests that the specimen is a female, but without dissection it is impossible to state so with certainty.

#### Genus *TENEROPSIS* novum

*Generic characters.*—Enopliinæ; head not very broad between the large, prominent, deeply emarginate, and moderately coarsely granulate eyes; labrum bilobed; terminal segments of both maxillary and labial palpi subcylindrical and slightly obliquely

truncate; antennæ ten-segmented, first segment stout and slightly bent, second slightly longer than broad, third to seventh of equal thickness, each shorter than the preceding, eighth and ninth broad, elongate-triangular, each as long as second to seventh, tenth elongate-cultriform. Thorax as long as greatest width, widest at basal third, tapering evenly anteriorly and posteriorly, lateral and basal margins entire, anterior coxal cavities moderately widely open behind. Elytra long, covering the abdomen, suture closed, distinctly broadest just behind the middle, punctuation confused, each elytron with very faint costæ. Abdomen with six visible ventral segments. Legs moderate, tarsi with five segments, the first partially concealed beneath the second, fourth very small, inserted between the lobes of the third, claws nearly simple.

Genotype, *Teneropsis sibuyanus* sp. nov.

This genus is probably much less closely related to *Tenerus* than the previous one. The gular region of the head is quite different and, while the antennæ are of the same number of segments as in *Teneromimus*, the funicular segments are comparatively long and distinct. Also, the tarsal claws are simple, a condition not commonly seen in this subfamily. The type species has somewhat the facies of an *Orthopleura*.

*Teneropsis sibuyanus* sp. nov. Plate 3, fig. 19.

Head with appendages, elytra, tibiæ, and tarsi almost black, thorax reddish brown, femora and underparts light piceous brown. Head coarsely and rather densely punctured, margin of eyes strongly beaded, supraantennal ridges prominent, surface sparsely pubescent with erect hair. Thorax finely and sparsely punctured, pubescence sparse, fulvous, anterior transverse impression broad and shallow, poorly defined. Scutellum black, transverse, feebly notched behind. Elytra together narrowly ovate, sutural margin beaded, lateral margins very slightly explanate, extreme basal margin and lateral margins to about basal third pale; punctuation in size of punctures similar to that of head, but more dense and confused; on the basal half there are a few single coarse punctures scattered among the fine ones; pubescence black, short, erect. Underparts finely but sparsely punctulate, except for the middle portion of the fifth sternite, which is very densely punctuate and pubescent; pubescence otherwise sparse. Length, 7.5 millimeters.

*Male*.—Fifth abdominal sternite with a small U-shaped notch at the middle of its posterior margin; sixth sternite and terminal tergite rounded.

*Female*.—Unknown.

Type, a male from Sibuyan (*Baker*).

#### KORYNETINÆ

*Subfamily characters*.—Cleridæ; eyes conspicuously though not always deeply emarginate; antennæ eleven-segmented, the three terminal segments forming a club. Lateral cariniform margin of prothorax distinct, at least toward the base, usually complete, anterior coxal cavities open behind. Elytra punctured in rows. Abdomen with the sixth sternite small, usually concealed by the fifth. Tarsi with five segments, the first sometimes small and partly concealed from above by the second, second and third large, fourth very small and indistinct, between the lobes of the third, fifth long. Claws simple or with basal tooth.

The genera that at present are assigned to this subfamily fall naturally into two groups, the first of these having a more or less oval form, the lateral cariniform margin of the pronotum complete, and the first tarsal segment moderately large. *Korynetes* Herbst, *Lebasiella* Spin., and *Necrobia* Oliv. are well-known examples of this type. The other group consists of such genera as *Tarsostenus* Spin., *Tarsostenodes* Blckb., and *Paratillus* Gorh., in which the form is very elongate-cylindrical, the lateral cariniform margin incomplete, and the first tarsal segment small and inconspicuous.

This subfamily is poorly represented in the Philippine fauna, only three species in two genera having been recorded from the Islands. The genera, one from each of the above-mentioned groups, are separable by the following characters:

##### *Key to the Philippine genera of Korynetinæ.*

- Form elongate-cylindrical, first tarsal segment small, concealed from above by the second; lateral cariniform margin of prothorax evident only near the base; terminal segments of both palpi triangular; tarsal claws toothed at base..... *Tarsostenus* Spinola.
- Form oval; first tarsal segment distinct; lateral cariniform margin of the prothorax complete; terminal segments of both maxillary and labial palpi cylindro-acuminate; tarsal claws simple..... *Necrobia* Olivier.

Genus **TARSOSTENUS** Spinola

*Tarsostenus* SPINOLA, Monog. Clérites 1 (1844) 287; LACORDAIRE, Gen. Col. 4 (1857) 452; JACQ. DU VAL, Gen. Col. d'Eur. 3 (1861) 198; BLACKBURN, Trans. Roy. Soc. South Australia 24 (1900) 138; SCHENKLING, Gen. Ins. (Wytsman) Cleridae (1903) 58; Col. Cat. (Junk) Cleridae (1910) 138; GAHAN, Ann. & Mag. Nat. Hist. VIII 5 (1910) 59.

*Generic characters.*—Korynetinæ, with the first tarsal segment small; head moderate, eyes moderately coarsely granulate, triangularly emarginate; antennæ eleven-segmented, basal segment stout, second longer than wide, third to eighth of equal width, each shorter than the preceding, ninth and tenth triangular, about twice as wide as eighth and somewhat longer, eleventh oval, longer than tenth but of equal width; labrum deeply emarginate, almost bilobed; terminal segments of both maxillary and labial palpi similar, triangular, subequal. Thorax with feeble lateral cariniform margin, present in the basal half, anterior coxal cavities open behind. Elytra covering abdomen, suture closed, punctures, in rows, becoming obsolete on apical half. Abdomen with sixth segment small, usually visible. Legs moderate, tarsi with five segments, the first and fourth small, second and third with lobes beneath; claws simple, somewhat swollen at base.

Genotype, *Tarsostenus univittatus* Rossi.

The genus at present consists of the single species which occurs over practically the entire globe. It is the most important predaceous enemy of the species of *Lyctus* which burrow in manufactured hardwood. Where the species originated is not known.

*Tarsostenus univittatus* Rossi. Plate 2, fig. 15.

*Tarsostenus univittatus* ROSSI, Fauna Etr. 1 (1792) 44; KLUG, Clerii (1842) 321; SPINOLA, Monog. Clérites 1 (1844) 288; JACQ. DU VAL, Gen. Col. d'Eur. 3 (1861) 198; LEWIS, Ann. & Mag. Nat. Hist. VI 10 (1892) 188; HOULBERT and BETIS, Trav. scient. Univ. Rennes 4 (1905) 131, fig. 34.

*Tarsostenus albofasciatus* MELSH., Proc. Acad. Philad. 2 (1846) 306; LECONTE, Ann. Lyc. Nat. Hist. New York 5 (1852) 17.

*Tarsostenus biguttatus* MONTRZ., Ann. Soc. Ent. France III 8 (1860) 260; FAUV., Bull. Soc. Ent. France V 5 (1875) 88.

*Tarsostenus fasciatellus* SPINOLA, Monog. Clérites 2 (1844) 172, pl. 8, fig. 5.

*Tarsostenus fasciatus* CURTIS, Brit. Ent. 6 (1832) pl. 270.

*Tarsostenus moerens* WESTWOOD, in White, Cat. Col. Brit. Mus., Cleridae (1849) 57; Proc. Zool. Soc. London (1852) 50, pl. 26, fig. 10; BLACKBURN, Trans. Roy. Soc. South Australia 24 (1900) 136.

*Tarsostenus picipennis* WESTWOOD, in White, Cat. Col. Brit. Mus., Cléridae (1849) 48.

*Tarsostenus succinctus* CHEVROLAT, Rev. Mag. Zool. (1842) 277; LACORDAIRE, Gen. Col. 4 (1857) 452 (footnote).

Form elongate-cylindrical; head very coarsely and sparsely punctured, the punctures slightly crowded near the antennal insertions, piceous; antennæ and palpi pale brown, the club of the former dark. Pronotum longer than wide, sides parallel in the anterior two-thirds, base somewhat constricted, margined; punctures very large, adjacent on the flanks, scattered on the disk; anteriorly, a depressed median area, posteriorly two depressed areas, one on either side of the median line, these areas more densely punctured, color piceous. Pubescence on head and thorax sparse, erect. Elytra piceous with a postmedian transverse bar of white, interrupted at suture; punctures large, arranged in ten rows which become obsolete just beyond the white bar; apical portion with fine punctures, irregularly placed. Underside of thorax sparsely and coarsely punctured, abdomen sparsely but more finely so. Legs moderate, femora somewhat thickened, tibiæ and tarsi slender. Length, 4 to 5 millimeters.

Widely distributed wherever beetles of the genus *Lyctus* are found. Professor Baker has collected the species on Basilan, and at Los Baños, Laguna Province, Luzon (Baker 14664).

#### Genus NECROBIA Olivier

*Necrobia* OLIVIER, Ent. 4 (1795) 76 bis; KLUG, Clerii (1842) 349; SPINOLA, Monog. Clérites 2 (1844) 98; LACORDAIRE, Gen. Col. 4 (1857) 490; GORHAM, Trans. Ent. Soc. London (1878) 159; SCHENKLING, Gen. Ins. (Wytsman) Cleridae (1903) 119; Col. Cat. (Junk) Cleridae (1910) 141.

*Agnonolia* MULSANT, Col. France, Augusticolles (1863) 122.

*Generic characters.*—Korynetinæ, with the first tarsal segment large, lobed beneath. Head moderate, eyes moderately coarsely granulate, rather deeply and conspicuously emarginate, labrum emarginate; antennæ eleven-segmented, first segment stout, second about as broad as long, third to eighth subequal in breadth, each shorter than the one preceding, ninth to eleventh forming a compact capitate club, terminal segment of both palpi cylindro-acuminate. Prothorax broader than long, lateral cariniform margin complete and distinct, anterior coxal cavities narrowly open behind. Elytra covering the abdomen, with coarse and fine punctures, the former arranged in more or less distinct rows. Abdomen with the sixth sternite small, usually

concealed by the fifth. Legs moderate, tarsi with the fourth segment very small, claws broadly toothed at base.

Genotype, *Necrobia violacea* (Linnaeus). Plate 3, fig. 27.

This genus contains about a dozen known species, of which three are more or less cosmopolitan. These insects infest drying or decaying animal matter, feeding on the larvæ of the true carrion insects. *Necrobia rufipes* DeG. is commonly met with in packing houses, about ham and bacon; *N. ruficollis* (Fabr.) appears to prefer partially dried bones; while *N. violacea* (Linn.) is attracted to carcasses of animals soon after their death. Since the last-mentioned species may be taken in the Philippines at a future date, I have included it in the following key with the two species already known from the Islands:

*Key to species of Necrobia Olivier.*

1. Upper surface bicolored, the thorax and base of the elytra red, rest of elytra and head metallic blue-green..... *N. ruficollis* (Fabricius).
- Upper surface entirely blue-green or blue..... 2.
2. Antennæ entirely black, legs bluish black..... *N. violacea* (Linnaeus).
- Antennæ with the basal segments castaneous, legs entirely castaneous.  
..... *N. rufipes* de Geer.

*Necrobia ruficollis* (Fabricius).

*Dermestes ruficollis* FABRICIUS, Syst. Ent. (1775) 57; KLUG, Clerii (1842) 350; SPINOLA, Monog. Clerites 2 (1844) 103, pl. 43, fig. 6; CHENU, Encycl. d'Hist. Nat., Col. 2 (1860) fig. 198; HOULBERT and BETIS, Trans. scient. Univ. Rennes 4 (1905) 134, fig. 41.

Form oval, depressed. Head coarsely and densely punctured, supraantennal ridges sharply defined, frons and vertex blue, occiput reddish, epistoma testaceous, labrum piceous; antennæ reaching to the base of the pronotum, ninth segment conspicuously narrower than the tenth; pubescence sparse, erect. Pronotum broader than long, widest across middle of length, sides angulate, margins beaded, surface coarsely, on the disk sparsely, on the flanks densely and confluent punctured. Elytra with nine rows of punctures, surface between the puncture rows finely punctulate, pubescence sparse and erect; color blue with the basal fifth reddish, the red continued along the lateral margin for a short distance. Underparts finely and densely punctured, reddish, the abdomen slightly darker, pubescence sparse. Legs moderate, the tibiæ fringed on the outer margin with long pale hairs. Length, 5 millimeters.

Cosmopolitan or nearly so. Though I have not as yet seen specimens from the Philippine Islands, the species has been

reported as from there by Gorham (1878). It should occur in or about the larger cities and towns, rather than on the less-settled islands.

*Necrobia rufipes* de Geer. Plate 2, fig. 17.

*Necrobia rufipes* DE GEER, Mém. 5 (1775) 165, pl. 15, fig. 3; KLUG, Clerii (1842) 350; SPINOLA, Monog. Clérites 2 (1844) 101, pl. 42, fig. 6.

*Necrobia amethystina* STEPH., Ill. Brit. 5 (1832) 417; KLUG, Clerii (1842) 394.

*Necrobia dermestoides* PILL et MITTERB., It. Poseg. (1783) 68, pl. 7, fig. 8.

*Necrobia foveicollis* SCHENKLING, Mitteil. Mus. Hamburg 17 (1900) 20.

*Necrobia glabra* CHAMPOLLION, Mag. Encycl. Millin. 3 (1814) 41; SCHENKLING, Bull. Mus. Nat. Hist. Paris 8 (1902) 332.

*Necrobia mumiarum* HOPE, Hist. Egypt Mum. Pettigr. (1834) 54, pl. 5, figs. 1-3; SCHENKLING, Bull. Mus. Nat. Hist. Paris 8 (1902) 332.

*Necrobia pilifera* REITZ, Verh. Nat. Vet. Brünn 32 (1894) (1893) 85; ABEILLE, Bull. Soc. Ent. France (1895) 208.

Form of *N. ruficollis*. Head very irregularly punctured, the punctures of two sizes, very coarse and very fine; antennæ with the basal segments reddish, the ninth as wide or nearly as wide as the tenth. Pronotum as in *ruficollis* but with the lateral margins more rounded, punctures coarse, sparse on disk, crowded at sides. Elytra with puncture rows very indistinct, surface between puncture rows densely and rather roughly punctured, from each puncture a hair arises which is directed backward instead of upward. Underparts moderately finely and densely punctured, sparsely pubescent. Legs moderate, tibiæ densely punctured, without conspicuous fringe of hairs. Length, 3.5 to 7 millimeters.

Cosmopolitan. This species varies considerably in size and color, the blue being frequently replaced by green. While I have seen but one Philippine specimen, from Tangkulan, Bukidnon Province, Mindanao, I am sure that the species must be widely distributed in the Islands.

#### BIBLIOGRAPHY

BARBOUR, THOMAS.

1911. The zoögeography of the East Indian Archipelago (translation of van Kampen 1909). Am. Nat. 45: 537-560.

1912. A contribution to the zoögeography of the East Indian Islands. Mem. Mus. Comp. Zool. Harvard 44: 5-203, pls. 1-8.

## BAER, G. A.

1886. Catalogue des Coléoptères des Iles Philippines. Ann. Soc. Ent. France VI 6: 97-200.

## BÖVING, A. G., and CHAMPLAIN, A. B.

1920. Larvae of North American beetles of the family Cleridae. Proc. U. S. Nat. Mus. 57: 575-649, pls. 42-53.

1922. The larva of the North American beetle *Zenodosus sanguineus* Say of the family Cleridæ. Proc. Ent. Soc. Wash. 24: 9-10, pl. 4.

## CASEY, THOMAS L.

1897. Coleopterological notices, VII. Ann. New York Acad. Sci. 9: 285-684.

## CASTELNAU, LAPORTE DE.

1836. Études entomologiques, ou descriptions d'insectes nouveaux et observations sur la synonymie. Silb. Rev. Ent. 4: 5-60.

## CHAPIN, EDWARD A.

1919. New species of Coleoptera (fam. Cleridæ) from the Philippines and neighboring regions, collected by Prof. Charles F. Baker. Proc. Biol. Soc. Wash. 32: 225-234.

1922. New species of Callimerus from Mindanao, Philippine Islands. Proc. Biol. Soc. Wash. 35: 133-134.

## CHENU, JEAN CHARLES.

1860. Encyclopédie d'histoire naturelle ou traité complet de cette science d'après les travaux des naturalistes les plus éminents etc. Coleoptera 2: 1-312, pls. Paris.

## CHEVROLAT, A.

1874. Catalogue des Clerides de la collection de M. A. Chevrolat. Rev. et Mag. Zool. III 2: 252-329.

1876. Mémoire sur la famille des Clérites 1-51. Paris.

## FABRICIUS, J. C.

1775. Systema Entomologiae sistens Insectorum classes, ordines, genera, species, adiectis synonymis, locis, descriptionibus observationibus 1-268. Flensburg et Lipsiae.

## GAHAN, CHARLES J.

1910. Notes on Cleridae and descriptions of some new genera and species of this family of Coleoptera. Ann. & Mag. Nat. Hist. VIII 5: 55-76.

## GORHAM, HENRY STEPHEN.

1876. Notes on the coleopterous family Cleridae, with descriptions of new genera and species. Cist. Ent. 2: 57-106.

1877. Descriptions of new species of Cleridae. Trans. Ent. Soc. London 245-263.

1877. Descriptions of new species of Cleridae, with notes on the genera and corrections of synonymy. Trans. Ent. Soc. London 401-426.

1878. Descriptions of new genera and species of Cleridae, with notes on the genera and corrections of synonymy. Trans. Ent. Soc. London 153-167.

1895. List of the Coleoptera in the collection of H. E. Andrewes Esq. from India and Burma, with descriptions of new species and notes. Families Malacodermata-Erotylidae-Endomychidae. Ann. Soc. Ent. Belg. 39: 293-330.

**GRAY, GEORGE.**

1832. The Animal Kingdom arranged in conformity with its organization by the Baron Cuvier etc. by Edward Griffith 14. Insecta 1, notices of new genera and species by George Gray 1-570, pls. London.

**HELLER, K. M.**

1921. New Philippine Coleoptera. Philip. Journ. Sci. 19: 523-637, pls. 1-3.

**JONES, CHARLES R.**

1913. The cigarette beetle (*Lasioderma serricorne* Fabr.) in the Philippine Islands. Philip. Journ. Sci. § D 8: 1-42, pls. 1-9.

**KLUG, J. C. F.**

1842. Versuch einer systematischen Bestimmung und Auseinandersetzung der Gattungen und Arten der Clerii, eine Insectenfamilie aus der Ordnung der Coleopteren. From Abhandl. Berl. Akad.

**KUWERT, A.**

1894. Revision der Cleridengattung Omadius Lap. Ann. Soc. Ent. Belg. 38: 62-97.

1894. Revision des Genus Stigmatium und der diesem Genus verwandten Gattungen nebst Bestimmungstabelle der mir zur Kenntniss gekommenen und bisher beschriebenen Arten. Ann. Soc. Ent. Belg. 38: No. 8, 398-457.

**LACORDAIRE, [JEAN] THÉODORE.**

1857. Histoire naturelle des insectes. Genera des Coléoptères, ou exposé méthodique et critique de tous les genres proposés jusqu'ici dans cet ordre d'Insectes 4. Paris.

**LATREILLE, P. A.**

1810. Considérations générales sur l'ordre naturel des animaux composant les classes des Crustacés, des Arachnides, et des Insectes; avec un tableau méthodique de leurs genres, disposés en familles. 1-444. Paris.

**LEFEBVRE, A.**

1835. Description d'un coléoptère nouveau du genre Clerus sous ses divers états. Ann. Soc. Ent. France I 4: 575-585, pl. 16.

1838. Nouvelles diverses. Bull. Ent. Soc. France I 7: 10-13.

**LEWIS, G.**

1892. On the Japanese Cleridae. Ann. & Mag. Nat. Hist. VI 10: 183-192.

1895. On the Dascillidae and Malacoderm Coleoptera of Japan. Ann. & Mag. Nat. Hist. VI 16: 98-122, pl. 6.

**LOHDE, REINHARD.**

1900. Cleridarum Catalogus. Stett. Ent. Zeit. 61: 3-148.

## MCGREGOR, RICHARD C.

1920. Some features of the Philippine ornis with notes on the vegetation in relation to the avifauna. *Philip. Journ. Sci.* 16: 361-437, pls. 1-35.

## OLIVIER, O.

1790. *Entomologie, ou Histoire naturelle des Insectes, etc.* 1-6 Paris.

## RUNNER, G. A.

1919. The tobacco beetle: an important pest in tobacco products. *Bull. U. S. Dept. Agr.* 737: 77, pls. 4, figs. 16.

## SCHENKLING, SIGMUND.

1903. Zur Systematik der Cleriden. *Deutsche Ent. Zeitsch.* 9-16.

1903. Genera Insectorum. Coleoptera Malacodermata, Fam. Cleridae. Bruxelles.

1906. Die Cleriden des Deutschen Entomologischen National-Museums, nebst Beschreibungen neuer Arten. *Deutsche Ent. Zeitsch.* 241-320.

1910. *Coleopterorum Catalogus auspiciis et auxilio W. Junk editus a S. Schenkling.* Pars 23: S. Schenkling, Cleridae. Berlin.

1913. Zwei neue Philippinische Cleriden. *Philip. Journ. Sci.* § D 8: 303-304.

## SCHULTZE, W.

1916. A catalogue of Philippine Coleoptera. *Philip. Journ. Sci.* § D 11: 1-194.

## SPINOLA, MAXIMILIEN.

1841. Monographie des Térédiles. *Revue Zool.* 4: 70-76.

1844. Essai monographique sur les Clérites insectes coléoptères 1 and 2, and one volume of plates. Geneva.

## THOMSON, JAMES.

1860. Matériaux pour servir à une monographie nouvelle de la famille des Clérides. Musée scientifique, 46-67.

## WESTWOOD, J. O.

1852. Descriptions of new species of Cleridae, from Asia, Africa, and Australia. *Proc. Zool. Soc. London* 20: 34-55, pls. (Annulosa) XXIV-XXVII.

1855. Descriptions of some new species of Cleridae, collected at Singapore by Mr. Wallace. *Proc. Zool. Soc. London* 23: 19-26, plate (Annulosa) XXXVIII.

1875. Description of a new genus of clerideous Coleoptera, from the Malayan Archipelago. *Trans. Ent. Soc. London* 241-242, pl. 9, fig. 1.

1876. Description of some new exotic species of coleopterous insects. *Trans. Ent. Soc. London* 493-495, pl. 2.

## WHITE, ADAM.

1849. Nomenclature of coleopterous insects in the collection of the British Museum, Part IV. Cleridae. London, British Museum.

## WOLLASTON, T. VERNON.

1854. *Insecta Maderensis*, being an account of the insects of the islands of the Madeiran group. pp. XLIII, 634, pls. 1-13. London.

## ILLUSTRATIONS

[Figures 1 to 21 show: *a*, antenna; *b*, labrum; *c*, maxillary palp; *d*, labial palp; *e*, claw; *f*, apex of tibia with tarsus. Figures 22 to 28 show thorax, ventral view, anterior coxae dissected away. Figures 29 to 46 show scale or color pattern of left elytron. Figures 47 to 58 show terminal sclerites of abdomen of male; *d*, dorsal view; *l*, lateral view; *v*, ventral view.]

### PLATE 1

- FIG. 1. *Cylidrus wallacei* Thomson.
- 2. *Cladiscus sanguinicollis* Spinola.
- 3. *Tillus notatus* Klug.
- 4. *Gastrocentrum unicolor* (White).
- 5. *Neohydinus pallipes* Kraatz.
- 6. *Cyrtinoclerus cyrtinoides* sp. nov.
- 7. *Callimerus lateralis* Chapin.
- 8. *Brachycallimerus latifrons* (Gorham).

### PLATE 2

- FIG. 9. *Omadius indicus* Castelnau.
- 10. *Anthicoclerus anthicoides* (Westwood).
- 11. *Orthrius binotatus* Fischer.
- 12. *Phaeocyclotomus tapetum* (Gorham).
- 13. *Stigmatium bakeri* sp. nov.
- 14. *Coptoclerus sericeus* sp. nov.
- 15. *Tarsostenus univittatus* Rossi.
- 16. *Teneroides melanopterus* sp. nov.
- 17. *Necrobia rufipes* de Geer.

### PLATE 3

- FIG. 18. *Allochotes bakeri* sp. nov.
- 19. *Teneropsis sibyanus* sp. nov.
- 20. *Tenerus magnus* sp. nov.
- 21. *Paratenerus mindanensis* sp. nov.
- 22. *Cladiscus sanguinicollis* Spinola.
- 23. *Phaeocyclotomus tapetum* (Gorham).
- 24. *Tillus notatus* Klug.
- 25. *Callimerus lateralis* Chapin.
- 26. *Neohydinus pallipes* Kraatz.
- 27. *Necrobia violacea* (Linnæus).
- 28. *Brachycallimerus latifrons* (Gorham).

### PLATE 4

- FIG. 29. *Callimerus princeps* Chapin.
- 30. *Callimerus bellus* Gorham.
- 31. *Callimerus fenestratus* Chapin.
- 32. *Callimerus intricatus* Chapin.

FIG. 33. *Callimerus schultzei* Schenkling.  
34. *Callimerus gratiosus* Gorham.  
35. *Callimerus flavus* Chapin.  
36. *Callimerus albus* Chapin.  
37. *Callimerus trifoliatus* sp. nov.  
38. *Callimerus pulchellus* Gorham.  
39. *Callimerus oculatus* Chapin.  
40. *Callimerus basilanicus* Chapin.  
41. *Callimerus octopunctatus* Heller.  
42. *Callimerus lateralis* Chapin.  
43. *Callimerus borneensis* Chapin.  
44. *Callimerus bisoconotatus* sp. nov.  
45. *Callimerus albescens* Chapin.  
46. *Brachycallimerus latifrons* (Gorham).

## PLATE 5

FIG. 47. *Callimerus bakeri* Chapin.  
48. *Callimerus luzonicus* Chapin.  
49. *Callimerus lateralis* Chapin.  
50. *Callimerus princeps* Chapin.  
51. *Callimerus intermedius* sp. nov.  
52. *Callimerus basilanicus* Chapin.  
53. *Callimerus fenestratus* Chapin.  
54. *Callimerus pulchellus* Gorham.  
55. *Callimerus albescens* Chapin.  
56. *Callimerus persimilis* Chapin.  
57. *Callimerus flavus* Chapin.  
58. *Callimerus gratiosus* Gorham.

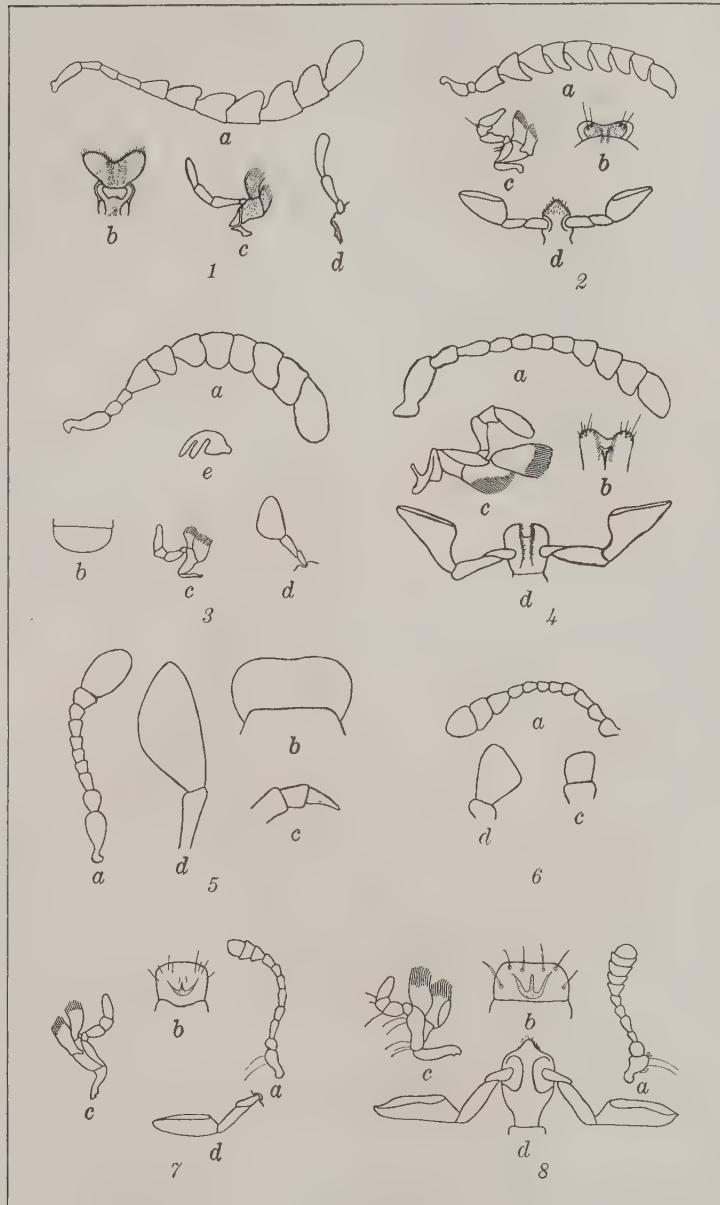


PLATE 1.



